15 Cents | JANUARY 1907 | $1.00 a Year

PUBLIC LIBRARY
CITY OF DETROIT.

THE FOUNDRY

THE PENTON
PUBLISHING COMPANY.

Cleveland | New York | Chicago | Pittsburg
Boston | Philadelphia | Cincinnati | Duluth

A New Riddle
The Rockwell

Write for Circular 150-E

The Rockwell has set a new standard in Riddle making and has already shown evidence of having an immense sale. The strength of the Rockwell lies in the fact that at the points where the ends of the rims and drivers lap, we bind these with a 1-inch strip of galvanized iron. The same binding is done at the inside lap of the rim and where the ends of the liners lap. We want you to use the Rockwell as it will give you at least one-third longer wear—this means a saving of one-third on your riddles.

Let us send you full descriptive circulars and prices

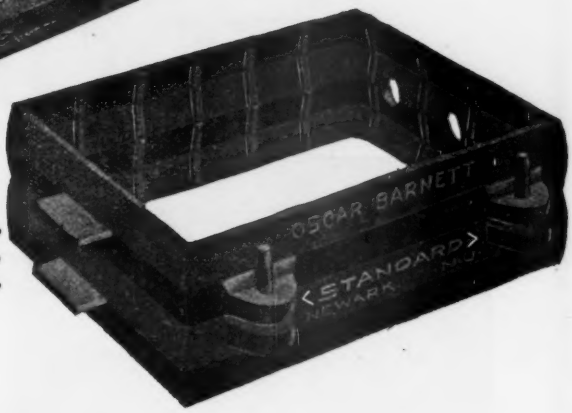
The S. OBERMAYER CO.

CINCINNATI CHICAGO PITTSBURG

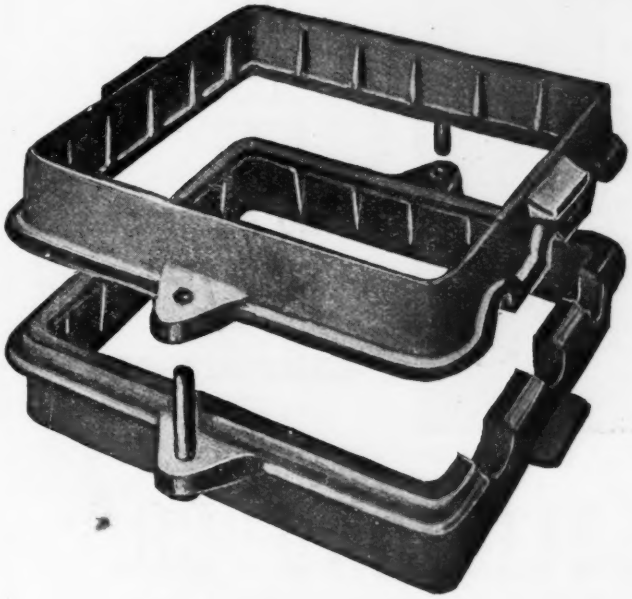
"Everything You Need in Your Foundry"

Brass Molders' Flasks

Of Every Style and Size



Furnaces, Drying Stoves, Spill Troughs, Clamps, Boards, Tongs, Crucibles, etc., etc.



All our flasks interchange with any of same size made by us.

Our own foundries ensure prompt shipments.

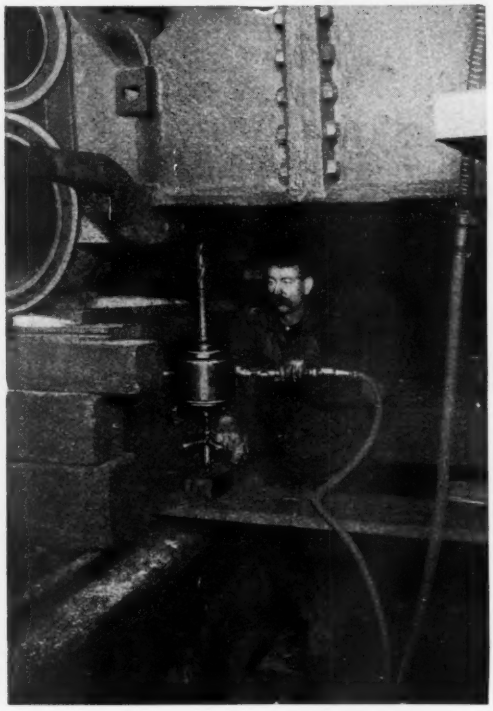
THE OSCAR BARNETT <STANDARD> FLASK IS MADE ONLY BY

Oscar Barnett Foundry Co.

Founded 1845 **NEWARK, N. J., U.S.A.**

"IMPERIAL" AND "HAESELER"

PNEUMATIC TOOLS



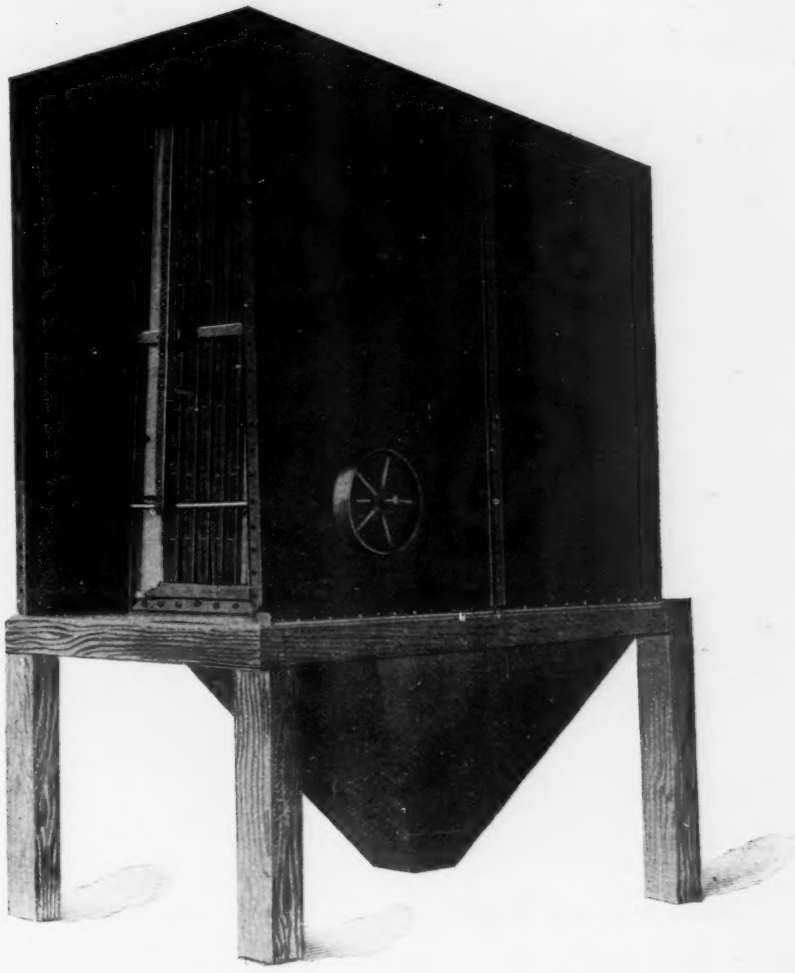
Two complete and distinct lines of established superiority. They are designed by practical engineers familiar with working conditions. This material is the best obtainable, improved by special treatments. Their workmanship is that of skilled mechanics, working under expert supervision in highly organized shops. They embody thirty-five years of pneumatic practice.

SAND RAMMERS
AIR HOISTS
AIR COMPRESSORS

INGERSOLL-RAND CO.

Chicago, Cleveland, Philadelphia, Houghton Mich., **11 Broadway NEW YORK**, St. Louis, Pittsburg, El Paso, Boston

H29



Steel Case Dust Arrester

We can take all the dust from your mill room coming from your cleaning mills, and return the air anywhere in your shop perfectly clean. No dust passes through the fan to cut out the blades. You can save the price of this Arrester in one year, taking into consideration the life of the Fan, wear and tear on machinery, and goods spoiled by dust.

Write us, and tell us your troubles. We manufacture a full line of Cleaning Room machinery, and if your cleaning room is not up-to-date, you are loosing 100% on it every year.

THE W. W. SLY MFG. CO.

Office and Works: Cor. Train and Junction Sts.,
CLEVELAND, O.

Books for Foundrymen

The Iron Founder

By the late Simpson Bolland, Esq., Practical Iron Founder. The Contents Comprise Core Making, Loam Molding, Dry Sand Molding, Green Sand Molding, with Miscellaneous Items, Recipes, Tables, Etc.

12mo. 382 pages, 308 illustrations. Cloth, $2.50.

The Iron Founder's Supplement

A Complete Illustrated Exposition of Art of Casting in Iron. Comprising the Erection and Management of Cupolas, Reverberatory Furnaces, Blowers, Dams, Ladles, Etc. Mixing Cast Iron; Founding of Chilled Car Wheels; Malleable Iron Castings; Foundry Equipment and Appliances; Gear Molding Machines; Molding Machines; Burning; Chilling; Softening; Annealing; Pouring and Feeding; Foundry Materials; Advanced Molding; Measurement of Castings; Wrought Iron, Steel, Etc. Also the Founding of Statues; the Art of Taking Casts; Pattern Modeling; Useful Formulas and Tables. By the late Simpson Bolland.

12mo. 392 pages, 208 illustrations. Cloth, $2.50.

Moulder's Text Book

Being Part II of American Foundry Practice. A Practical Treatise on Molding. Discussing the Question of Economy in Casting and the Arrangement of a Foundry in Regard to Rapid Work. Treating of Cupolas, Methods of Firing, Best Means of Securing Perfect and Sound Castings, Etc. Being a Continuation of Vol. I on this Subject, and Dealing with a Class of Work Requiring More Skill and Greater Care. By Thos. D. West. With Numerous Illustrations. Ninth Edition. Revised and Enlarged.

12mo. 518 pages, 146 illustrations. Cloth, $2.50.

American Foundry Practice

Treating of Loam, Dry Sand and Green Sand Molding, and Containing a Practical Treatise on the Management of Cupolas and Melting of Iron. By Thomas D. West, Practical Iron Molder. Tenth Edition. Revised.

12mo. 408 pages, fully illustrated. Cloth, $2.50.

The Encyclopedia of Founding and Dictionary of Foundry Terms

Used in the Practice of Molding. Together with a Description of the Tools, Mechanical Appliances, Materials and Methods Employed to Produce Castings in all the Useful Metals and their Alloys, Including Brass, Bronze, Steel, Bell, Iron and Type Founding. With many Original Mixtures of Recognized Value in the Mechanical Arts. Also Aluminum, Plating, Gilding, Silvering, Dipping, Lacquering, Staining, Bronzing, Tinning, Galvanizing, Brittaniaware, German-silver, Nickel, Soldering, Brazing, Ores, Smelting, Refining, Assaying, Etc. By the late Simpson Bolland.

12mo. 535 pages. Cloth $3.00

"ABC" of Iron

A practical book for foundry foremen. It contains the real serviceable information such as you need. No foundryman can afford to be ignorant of the nature and properties of iron. Read the contents and consider its value to you.

Iron—What is it? Pig Iron. Constituents of Iron. Numbering of Pig Iron. Grading of Iron. How to Reduce Cost of Mixture Steel. Physical Properties of Metals Defined. Statistics. Early History and Manufacture of Iron.

Good cloth binding, 118 pages. $1.00.

We have educational books of all kinds along mechanical lines.

For above or any other, address

BOOK DEPARTMENT

The Penton Publishing Company

CLEVELAND

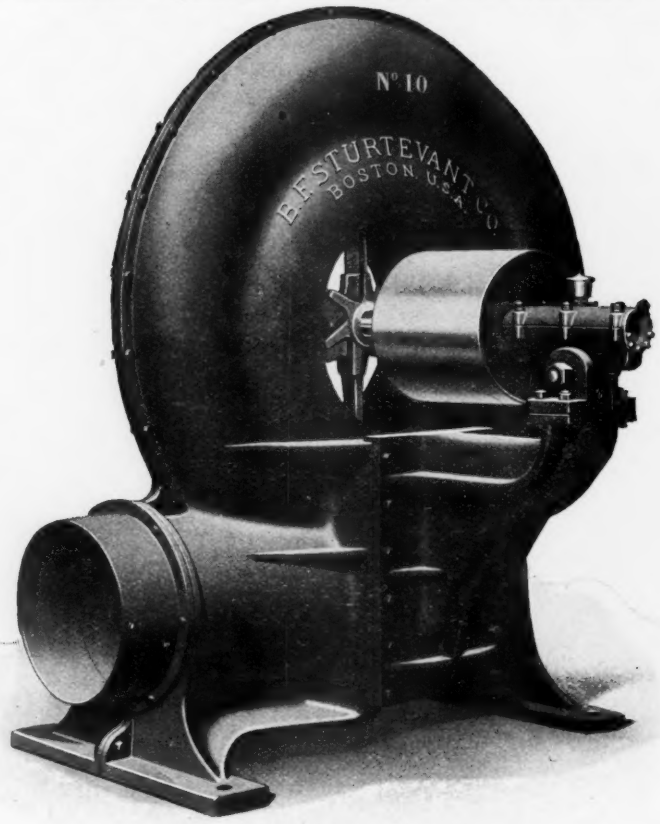
FOUNDRY CHAPLETS AND ANCHORS
W. W. Lindsay & Co.
Harrison Building
PHILADELPHIA, PA.
U. S. A.
Cable Address
"LINDIRON, PHILADELPHIA"
W. W. Lindsay & Co.
Harrison Building,
Philadelphia, Pa.

Sturtevant Blowers

For

Foundry Cupolas

These blowers have been in use for nearly fifty years and enjoy a worldwide reputation for efficiency and endurance.



B. F. STURTEVANT COMPANY

BOSTON, MASS.

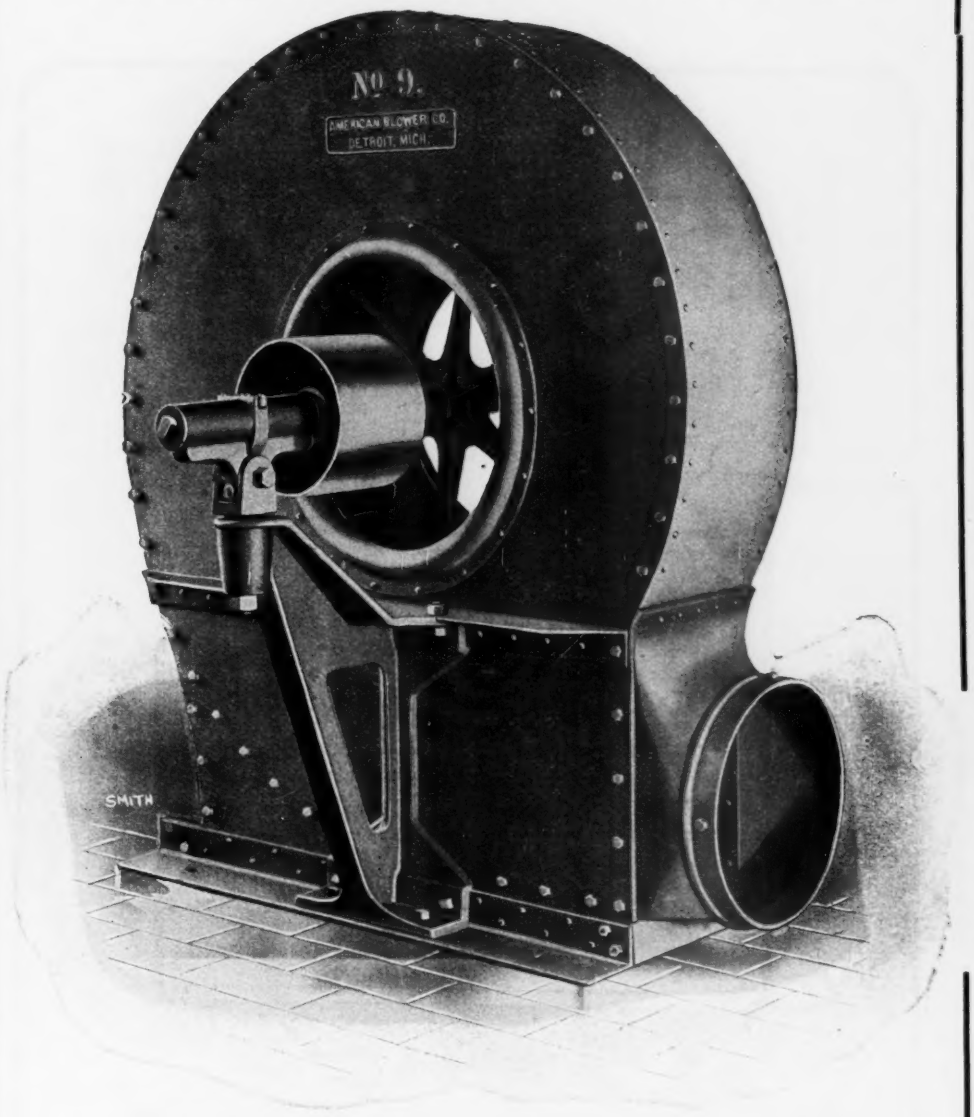
General Office and Works, Hyde Park, Mass.

New York Philadelphia Chicago Cincinnati London

Designers and Builders of Heating, Ventilating, Drying and Mechanical Draft Apparatus; Fan Blowers and Exhausters; Rotary Blowers and Exhausters; Steam Engines, Electric Motors and Generating Sets; Pneumatic Separators, Fuel Economizers; Forges, Exhaust Heads, Steam Traps, Etc.

401

"A B C"
STEEL PRESSURE BLOWER



All parts of this Blower are steel plate, except the bearings and brackets, shaft, hub and pulley. It is indestructible, stiff, tight, smooth and handsome.

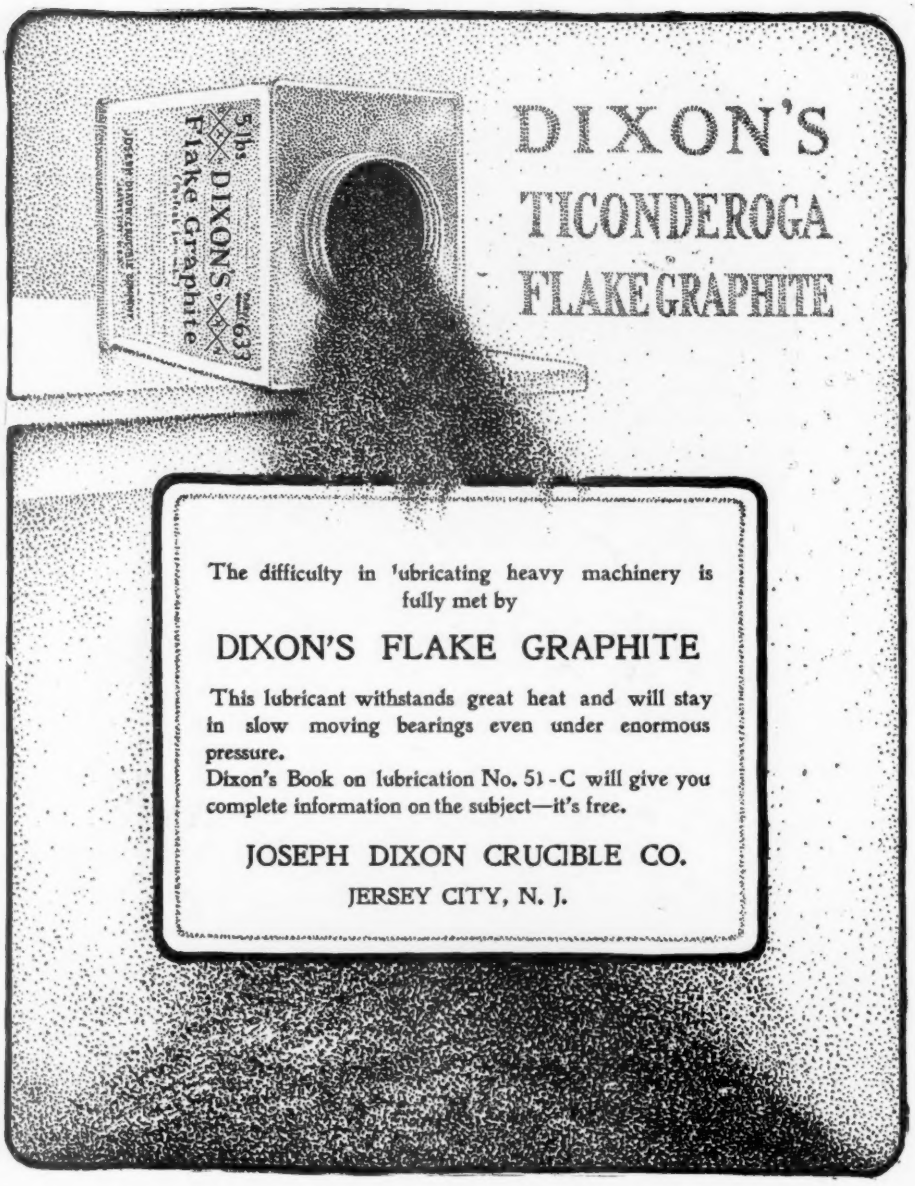
The bearings are long, self-oiling, self-aligning in every direction, and finely finished.

The wheel is given a running balance, being perfectly smooth and quiet in operation.

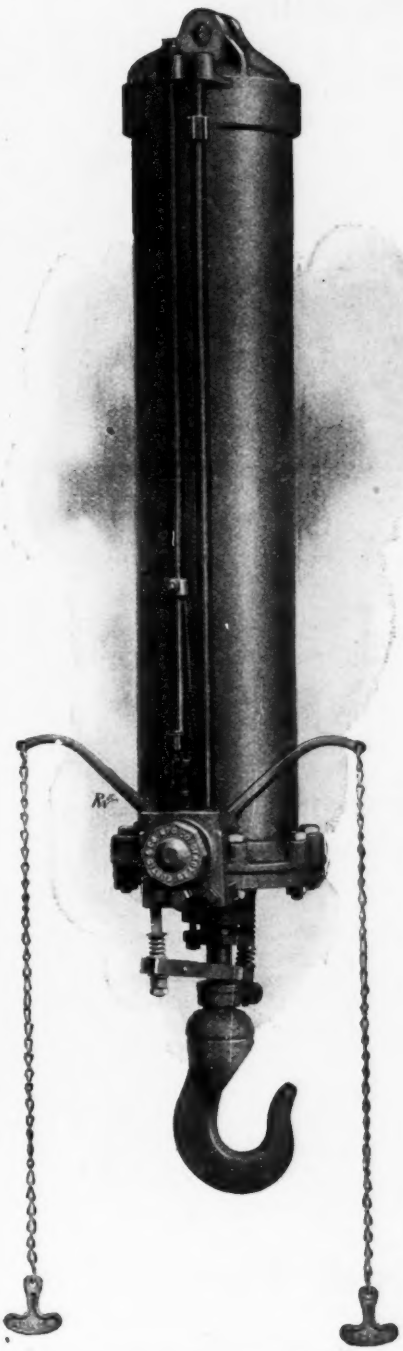
These points are elaborated in Catalogue No. 190. Shall we send it to you?

AMERICAN BLOWER CO.,
DETROIT

New York Chicago Atlanta London


5 lbs
DIXON'S
Flake Graphite
No. 633
DIXON'S
TICONDEROGA
FLAKE GRAPHITE
The difficulty in lubricating heavy machinery is fully met by
DIXON'S FLAKE GRAPHITE
This lubricant withstands great heat and will stay in slow moving bearings even under enormous pressure.
Dixon's Book on lubrication No. 51-C will give you complete information on the subject—it's free.
JOSEPH DIXON CRUCIBLE CO.
JERSEY CITY, N. J.

The CURTIS HOIST



AIR BALANCED

NO JUMP
OR JERK

Will Handle the Most Difficult Moulding

Made in sizes from 3″ diameter 450 lb. capacity, to 19″ diameter 20,000 lb. capacity.

PNEUMATIC ELEVATORS
AIR COMPRESSORS
OVERHEAD TROLLEY
SYSTEMS

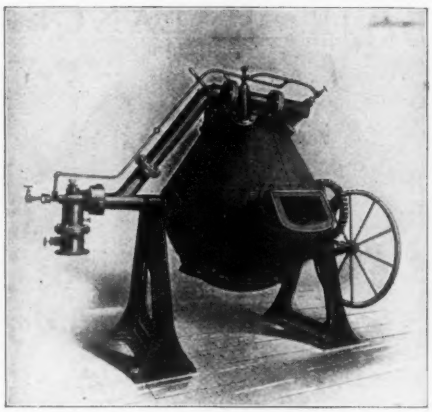
Manufactured by

Curtis & Co. Mfg. Co.
ST. LOUIS

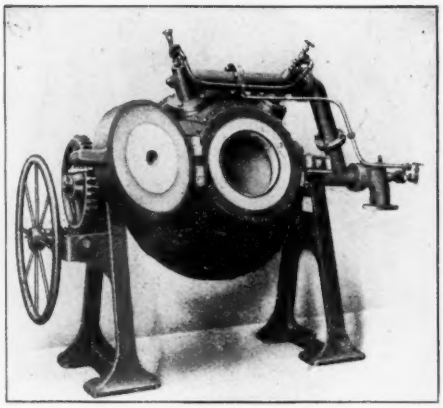
Baird Machinery Co., - - - Pittsburg
A. E. Hoermann, No. 41 Park Row New York
Hill, Clark & Co., - - - - - Boston

Schwartz Melting and Refining FURNACE

Simplicity—Durability



Melting position



Charging position

Best and cheapest method for melting brass, copper, bronze, gray iron and malleable iron.

Produces better metal and perfect castings. Less loss in shrinkage and no ashes. No crucibles are required.

Made in sizes from 100 lbs. to 10,000 lbs. capacity.

Fuel used: crude oil, fuel oil or gas.

SCAN THIS LIST OF SOME USERS

A recommendation in itself

J. B. Clow & Son
Crane Co.
Manning, Maxwell & Moore
Hewitt Mfg. Co.
Atlantic Brass Co.
Otis Elevator Co.
U. S. Navy Yards
General Electric Co.
Roe Steel Co., Middlesex, Eng.
Ludlow Valve Co.
Erie R. R.
D. & R. G. R. R.
C. R. I. & P. R. R.
L. & N. R. R.
Gr. Northern R. R.
Smeeth Copper Co.
Best Mfg. Co.
International Steam Pump Co.
American Locomotive Co.
Magnus Metal Co.
Westinghouse Electric Co.
Westinghouse Air Brake Co.
Newport News Shipbuilding Co.
British Admiralty, Chatham, Eng.
Nathan Mfg. Co.
C. B. & Q. R. R.
A. T. & S. Fe R. R.
Seaboard Air Line
N. & W. R. R.
B. & M. R. R.

"Sold on guaranteed results"

Write for new catalogue.

The Hawley Down Draft Furnace Co.

CHICAGO U. S. A. NEW YORK

We cordially invite the representative Brass Foundry interests of the country to a complete investigation of the advantages and merits of

The "Steele-Harvey"
CRUCIBLE BRASS MELTING FURNACE

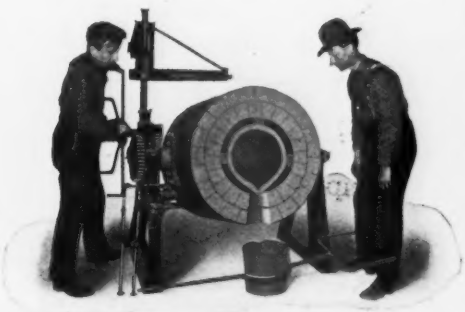
over the old coke or coal method.

Our experience and knowledge of the interests of the Foundry has been based upon an experience commencing with the old way, and developing by degrees to the present, in connection with Oil or Natural Gas and Air. We do not claim **impossible** or **extraordinary** advances, but a development of the method of melting, which is **clean, economical, labor saving,** above ground, **no ashes,** or **waste** of metal therein, a **reduction** in **cost** of fuel, using that only **which is necessary to melt** a given quantity of metal, **one** furnace doing what **3** similar coke crucibles formerly accomplished. An honest machine, which if purchased will economize for cost value within a short time, **rapidity** of **melting**—reduction in **loss**—and extension in life of crucible—maintaining a **high quality** of **metal**

Our Standard

(Patented in the United States and all foreign countries.)

IN MELTING POSITION



IN POURING POSITION

When you want it—"**It is there with the goods.**" **Do not hesitate,** but request one on **trial** and **approval,** and acceptance when satisfactorily demonstrated by our representative. On account of the enormous demand we have doubled our plant capacity and are in position to ship within 24 hours of receipt of order.

Built for capacities from **120** to **1,500** lbs. **per heat.**

Don't delay—"the other fellow will get ahead."

Write for Catalog.

The Monarch Engineering & Mfg. Co.

BALTIMORE, MD., U. S. A.

Works: Curtis Bay, Md.

EUROPEAN DEPOT—J. W. Jackman & Co., Ltd., "Caxton House," Westminster, London.

Have you enough Good Iron?

The consumption of iron during 1907 promises to exceed all previous records. Choice brands of foundry irons will continue to be scarce. Avoid the off-grade concession and place quality before quantity. Remember our guarantee---QUALITY (soft, strong and uniform) in all shipments of CHERRY VALLEY IRON---the iron with all the features a good foundry iron should possess. It makes an ideal mixture for machinery castings, as a trial will prove. The trial is all we want---all we need, to secure a foothold on your future business.

THE CHERRY VALLEY IRON CO.
Pittsburg

William Sellers & Co., Incorp.

PHILADELPHIA, PA.

Modern Machine Tools

We illustrate hereunder one of our specialties for Foundry use, which has proved very satisfactory and profitable in service.

Centrifugal Sand Mixing Machine

We have furnished these machines to many users and shall be pleased to supply full particulars upon application.

TRAVELING CRANES JIB CRANES

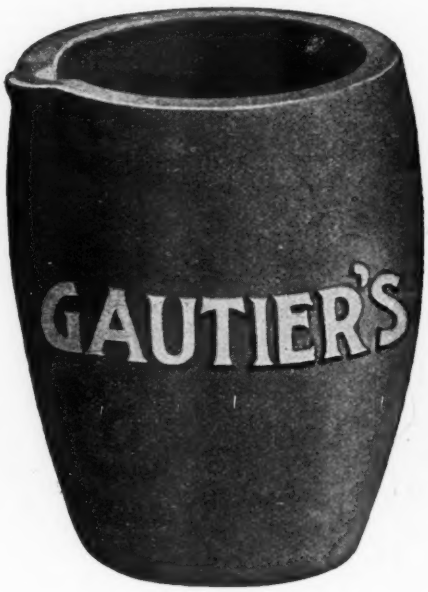
SHOP TURNTABLES

Improved Injectors for Boiler Service

SHAFTS, HANGERS, PULLEYS, COUPLINGS, Etc.

FOR THE TRANSMISSION OF POWER.

A Dependable Crucible for all Metals



The Standard
of crucible excellence
and uniformity, for half a century

J. H. Gautier & Co.
JERSEY CITY, N. J.

This trade mark stands for the acme of crucible uniformity.

Our Crucibles for melting Gold, Silver, Brass, Steel, Copper, etc., are perfectly uniform in quality, as we work strictly by chemical analysis. We can fill orders promptly as we keep a large stock of the different sizes constantly on hand.

A trial will convince you.

Robert J. Taylor, Incorporated

1900 to 1916 Callowhill Street

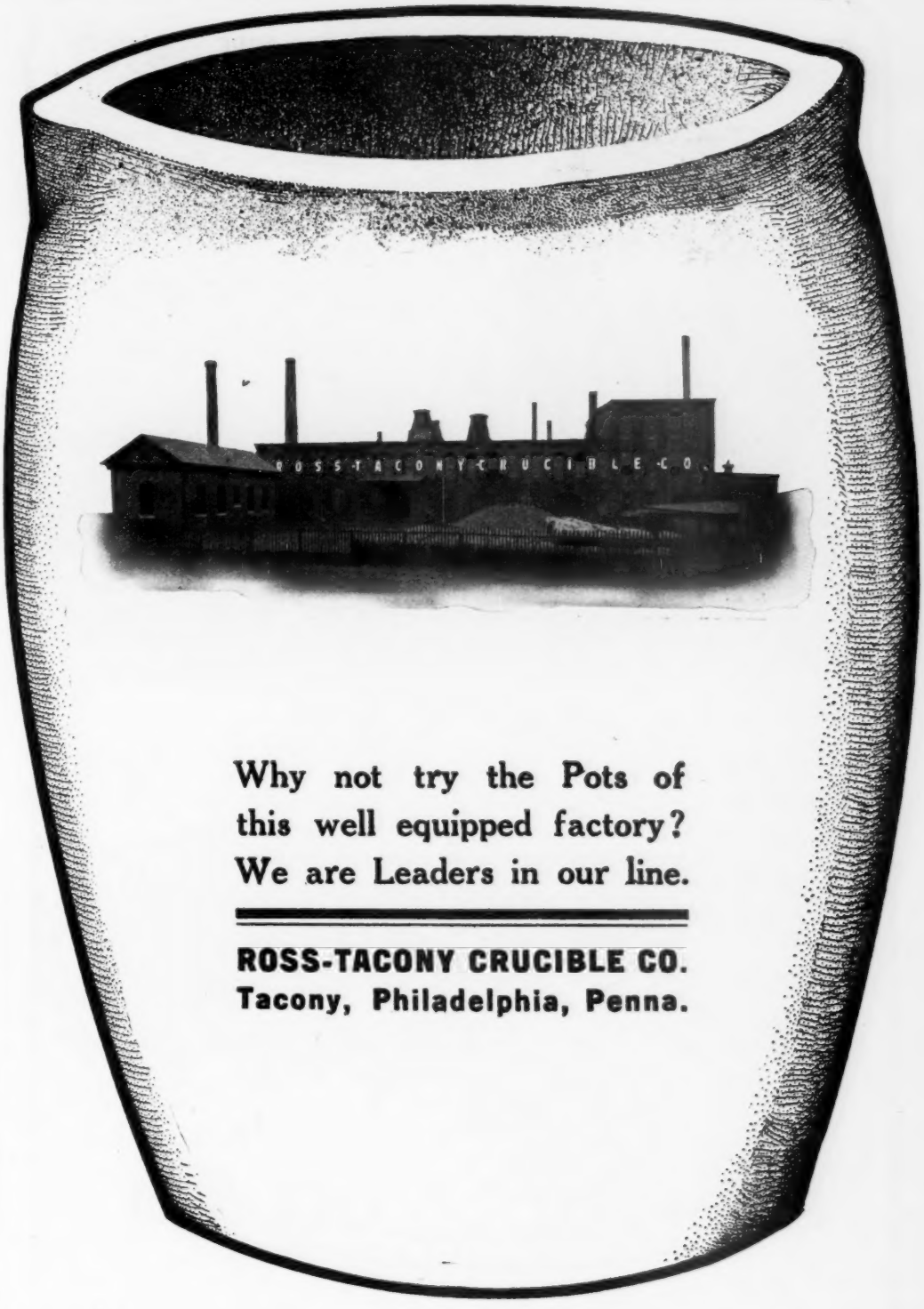
PHILADELPHIA, PA.

"Under cover, from start to finish" is more than a phrase—applied to McCullough-Dalzell Crucibles, it's a letter of introduction.

Get acquainted—write for prices to-day.

McCullough-Dalzell Crucible Co.

Pittsburgh
Pa.



Why not try the Pots of this well equipped factory? We are Leaders in our line.

ROSS-TACONY CRUCIBLE CO.
Tacony, Philadelphia, Penna.

C. E. Mills, Specialist

REFERENCES GIVEN TO THE LARGEST FOUNDRIES IN THE COUNTRY.

MILLS DRY CORE COMPOUND

No. 1 for heavy or ordinary Core-making No. 2 for any work, but is especially adapted for Malleable Iron, Brass and Steel Foundries. It goes three times as far as Rosin, and twice as far as Flour. No blow and no absorption of moisture.

SYRACUSE X-XX-XXX CORE OILS

Perfect adaptation for all work. Best Core Oil on the market.

SYRACUSE LADELENE COMPOUND

Facing, Core Wash, Lining for Ladles, Cupolas. Locomotive and Stationery Fire Boxes, Gas Work, etc.

Half the cost making cores with our MILLS DRY CORE COMPOUND.

We have Agencies in the following cities, who carry our goods in stock, whose territories are as specified:

GOLDEN RULE OIL CO., 171 Washington St, Chicago, Ill.
Agents, Cooke County, Illinois, and State of Iowa.

HILL & GRIFFITH CO., Cincinnati, O.
Southern Agents.

WHITEHEAD BROS. CO., Providence, R. I.
Agents for New England.

THE DOMINION FOUNDRY SUPPLY CO., Ltd., Agents for Canada.
Offices and Warehouses—122 Wellington St., Toronto, Ont
and 47 Murray St., Montreal, Que

C. E. MILLS OIL CO.

Sole Manufacturers

SYRACUSE, N. Y.

PERFECTO

LIQUID CORE COMPOUNDS

GRADED TO SUIT YOUR FOUNDRY CONDITIONS

POSSESSING FOLLOWING
STRONG FEATURES

Very Little Gases
Easy Peeling of Core
Non-Blowing Qualities
Highest Binding Value

TRIAL SOLICITED

MANUFACTURED BY

FRANK L. YOUNG & KIMBALL
Boston, Mass.

BRANCHES:

Chicago New York Philadelphia New Bedford Liverpool

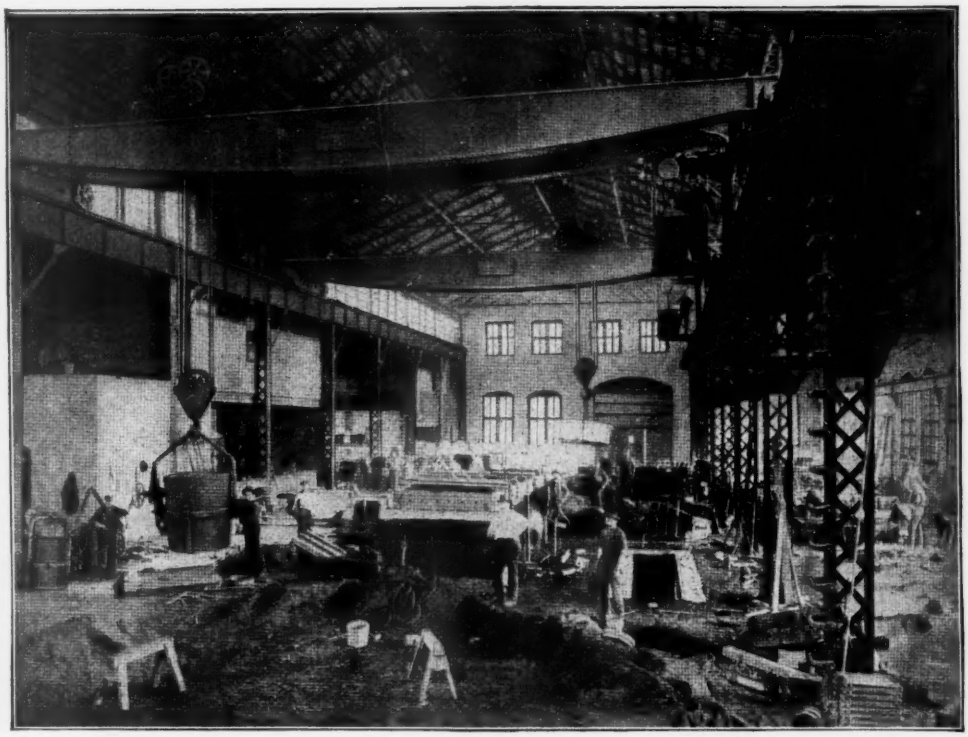
Represented by W. EDWARD BAIRD

Agents for Canada
HAMILTON FACING MILL CO., Limited
Hamilton, Ont.

WHITING FOUNDRY EQUIPMENT CO.

General Office and Works, HARVEY, ILL., U. S. A. (Chicago Suburb)

Engineers Designers Manufacturers



Two Three-Motor Electric Traveling Cranes, capacity twenty tons. Bates Machine Co., Joliet, Ill.

Cupola, 2000 in use.

ELECTRIC TRAVELERS CRANES OF ALL TYPES

Cupolas and **Machinery** for **Complete equipment** of **Foundry Plants. Contracts taken covering buildings** and **entire Installations. Inquiries Solicited.**

Have you our Catalogs? If not, send for them. Tell us about your Foundry Plans—we may be able to assist you.

THE FOUNDRY

Vol. 29, No. 5. *CLEVELAND, OHIO, JANUARY, 1907.* *Whole No. 173*

BEGINNING OF AMERICAN MALLEABLE IRON.

THE BIRTHPLACE OF A MODERN INDUSTRY.

Early Experiments and Original Patents.

At No. 28 Orange street, Newark, N. J., in a little side street half hidden behind the tumble-down factory where the world's most famous talcum powder is prepared, there is an old foundry which has a history. The story of its earlier years is in fact the history of the beginning of the industry in this country; for it was there that Seth Boyden began casting and annealing buckles and bits for the harness makers some eighty years ago, and it was there that all the early malleable iron founders learned the art of decarbonizing castings. Since the days when the foundry occupied a part of the lot behind Mr. Boyden's home, the business has been carried on under many different names, but it has always held an important place in the trade. Of late years it has grown so much that it is beginning to feel cramped in the original quarters. Before long the historic site must be deserted for new ground where there will be more room.

FIG. 1.—GENERAL VIEW OF THE PRESENT PLANT.

Very little of the original plant remains. A part of the old wall still does duty at one side of the foundry. In a busy place many changes are inevitable in the course of eighty years. The

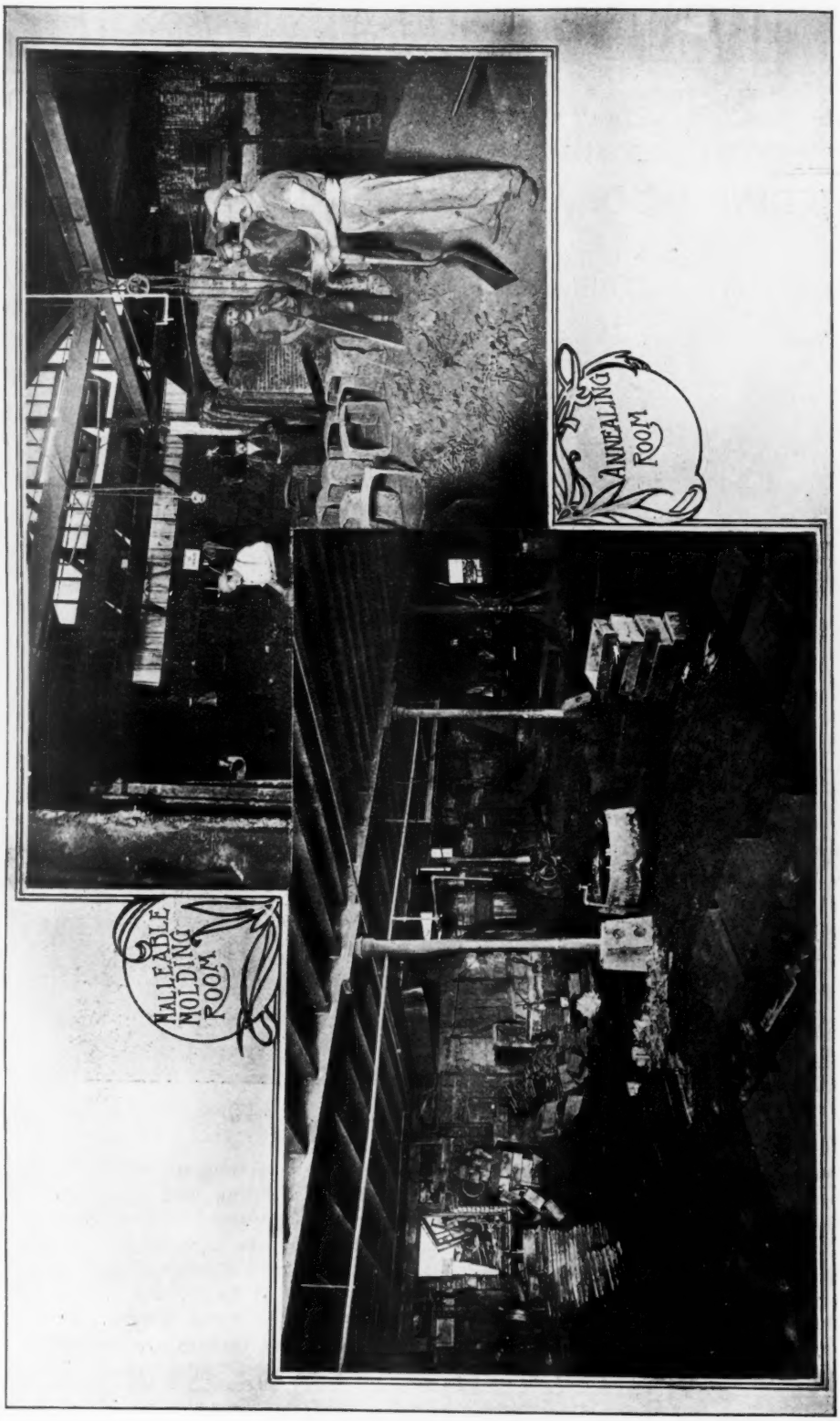


FIG. 5.—TWO VIEWS IN THE PRESENT PLANT.

foundry does not present an imposing front. There is the apparent lack of design common to all structures built on the order of growing necessity rather than according to a definite plan, but it is far more extensive than the photograph would lead one to suppose. The ground is crowded with buildings and the yards are narrow. There are many modern features, although a model arrangement for the economic handling of material must wait until the plant can be rebuilt elsewhere.

Seth Boyden here began the production of malleable castings in 1826. He continued in the business only nine years, until 1835, when the Boston Malleable Cast Iron & Steel Co. bought him out, and also his brother, Otis Boyden, who in the meantime had started the Crockett foundry, also in Newark. But the early consolidation seems not to have been successful. The Boston company failed two years later, when the foundry passed into the hands of Condit & Bolles, under whose management it continued until 1843. Since then the office stationery has borne the following names: Daniel Condit, 1843-1858; Condit & Barlow, 1858-1862; Condit, Barlow & Shove, 1862-1866; Barlow & Shove, 1866-1870; J. H. Barlow, 1870-1879; J. H. Barlow & Condit, 1879-1882; Barlow, Condit & Morris, 1882-1895; Morris & Barlow, 1895-1899, and from 1899 to the present time that of the present proprietor, Arthur E. Barlow, son of the J. H. Barlow, whose name is prominent from 1858 on.

When the history of the malleable iron industry in this country comes to be written, three names will stand out prominently, all belonging to men who have spent active years in this foundry —Seth Boyden, J. H. Barlow and William G. Morris. Of these, Mr. Barlow held the most modest part, for he devoted his time and energies chiefly to the office and not to the technical end of the business. William G. Morris practically grew up in the environments of the plant, and later as head of the business was regarded as one of the highest authorities on the founding of light castings, and by many as the very highest in the art of malleable iron making. He was the son of a foundryman, his father having served his apprenticeship under Seth Boyden. He died in 1898 while in attendance at a meeting of the Philadelphia Foundrymen's Association.

Although he spent only a comparatively small part of his extremely active life in the business, still it is Seth Boyden whose memory lends especial interest to the place. It was on this spot that he carried on his laborious experiments extending over a period of six years, and it was here that he laid the foundations of a great American industry. The citizens of Newark think so highly of his labors that his statue occupies the most conspicuous place in the city park, almost within stone's throw of the site of his workshop. He was a remarkable man and probably enjoyed every hour of his long life, although he died poor, on a farm presented to him by those who had made fortunes free from the use of his numerous inventions. A list of the industries which profted by his genius would be too long for the present paper. His activities ranged from the manufacture of patent leather to improve-

FIG. 2.—SETH BOYDEN.

ments in the culture of strawberries, the last of his enterprises—the Boyden strawberry—is still highly esteemed. He invented a process for the production of Russia sheet iron; built machines for making nails; opened a plant for the manufacture of engines and locomotives; invented the link-motion and a cut-off for steam engines, both of which

FIG. 3.—STATUTE OF SETH BOYDEN, IN NEWARK.

he neglected to patent. Indeed, he seems to have valued commercial success not at all. As soon as he had brought a machine or a process to mechanical success he seems to have lost interest in it.

The problem of malleable iron casting occupied Boyden's attention probably longer than any of his other interests. Besides the years spent in experiment he worked nine years managing the growing business. Under his care it grew from a small shop to an establishment employing 60 molders. In 1835 he sold out for $25,000. The notes describing his experiments are, so far as they have been preserved, extremely interesting. They were admirably reviewed and commented upon some years ago by George C. Davis, in a paper read before the Philadelphia Foundrymen's Association.

It is not generally claimed that Boyden actually invented the process of making malleable iron castings, for his notes show that he had specimens of soft iron made in England and he knew the secret of annealing. But his advance information must have been extremely meager; he worked out practically every point in the process by his own experimental studies. The earliest trials were made in his house, the iron being melted in crucibles in a forge fire and the castings annealed in a small furnace erected in the fireplace. In this way he made twelve experiments to determine the quality of pig iron to be used, the best packing, the temperature for annealing, etc. An entry in his notes dated July 4, 1826, under the heading "Experiments in the Foundry," shows that the results had by that time been so satisfactory that he had felt justified in providing a plant.

In 1828 the Franklin Institute, of Philadelphia, offered a silver medal for the best specimen of annealed cast iron to consist of not less than one dozen pieces. The following is from a report of a committee of that year: "Premium No. 4, for the best specimen of annealed cast iron, is awarded to Seth Boyden, of Newark, N. J., for specimen No. 163, being an assortment of buckles, bits and other castings remarkable for their smoothness and malleability. This is the first attempt in this country to anneal cast iron for general purposes that has come under the knowledge of your committee, and the success attending it fully entitles the maker to a silver medal" Boyden had been in the silver plating business, and it was to find a less expensive method of producing harness hardware than by the blacksmith's hammer that he first began to study the annealing process. A visitor to the foundry today will find that the manufacture of bits and buckles is still an important industry there.

Some of the early experiments are somewhat amusing when considered by the light of our more extensive knowledge of chemistry and thermal physics. Thus, various substances were added to the molten iron, such as sulphur, phosphorus, tin, zinc, lead, antimony and nickel, which did not improve matters, and additions of this sort were soon abandoned. An entry dated 1832 contains the following in reference to melting on a basic lining: "The more iron is free from carbon, the stronger heat is required to anneal it; lime on bottom in place of sand, iron equally good."

To discover independently the proper method of annealing was no simple matter. The first reference to well annealed castings is dated Oct. 20, 1826: "I have a piece so good it will not harden any more than copper, and when hammered is scarcely inferior to the best wrought iron." At a number of places he speaks of keeping the pots at a temperature to melt silver. He had an ingenious device for awakening him in the night when the furnace needed more fuel. A burning candle impaled on a nail served as an alarm clock. When the candle had been consumed as far as the supporting nail the butt fell by force of gravity, striking a sounding piece of metal in its fall.

Naturally, there were many failures. For packing, various kinds of native ore were used, also Spanish brown hematite, manganese ore, sand, clay, lime, ashes, hammer scale and many mixtures, including saltpeter, alum, sal-ammoniac and plaster of paris. Under date of April 3, 1827, he writes: "The conclusion is that red oxide of iron is important and in fact the best thing known for packing, and Sterling, well refined, the best iron." The Sterling iron was obtained from the Sterling Iron Works, in Orange county, New York, near the present Tuxedo.

Once established on a practical footing, the business grew rapidly, soon requiring the services of 60 molders. At first the iron was melted in crucibles heated with charcoal or hard coal, and lime was the usual flux, although many other substances were also tried. Soon an air furnace was built having a capacity of about a thousand pounds. The fuel was dry pine wood or coal, and it is said that eight heats a day were made, beginning at three in the morning and continuing until late at night. The furnace was not tapped, the iron was removed by dipping with clay-washed ladles holding from 10 to 12 pounds each.

FIG. 4.—J. H. BARLOW.

A mixture of coal and rosin known as "patent fuel" was used in 1831, rosin being at that time very cheap. There is in the library of Newark the original patent granted to Seth Boyden, and signed by Andrew Jackson, for a mixture of this kind, the claim being, however, for an improvement in the manufacture of malleable cast iron. The following is a copy of the essential portions of the document:

THE UNITED STATES OF AMERICA.

To all to whom these LETTERS PATENT shall come:

WHEREAS, Seth Boyden, a citizen of the United States, hath alleged that he has invented a new and useful improvement in the manufacture of malleable cast iron, which improvement he states has not been known or used before his application; hath made oath that he

does verily believe that he is the true inventor or discoverer of the said improvement; hath paid into the Treasury of the United States the sum of thirty dollars; delivered a receipt for the same, and presented a petition to the secretary of state, signifying a desire of obtaining an exclusive property in the said improvement, and praying that a patent may be granted for that purpose: THESE ARE THEREFORE to grant, according to law, to the said Seth Boyden, his heirs, administrators or assigns, for the term of fourteen years, from the ninth day of March one thousand eight hundred and thirty-one, the full and exclusive right and liberty of making, constructing, using and vending to others to be used, the said improvement; a description whereof is given in the words of the said Seth Boyden, himself, in the schedule hereto annexed, and is made a part of these presents.

IN TESTIMONY WHEREOF, I have caused these Letters to be made Patent, and the Seal of the United States to be hereunto affixed.

GIVEN under my hand at the city of Washington, this ninth day of March, in the year of our Lord one thousand eight hundred and thirty-one and of the independence of the United States of America fifty-fifth.

By the President,

ANDREW JACKSON.

M. VAN BUREN,

Secretary of State.

The schedule referred to in these letters patent, and making part of the same, contains a description in the words of the said Seth Boyden himself, of his improvement in manufacturing malleable cast iron.

The improvement consists in mixing rosin, pitch, or tar, with bituminous coal, and applying it as fuel for melting and converting crude or pig iron to malleable castings—the coal is pulverized or broken in pieces of a size suited to the furnace grate, and mixed with rosin, pitch or tar, in a proportion as the intensive heat is desired, and applied in quantities diminishing in proportion as the rosin is increased.

In testimony whereof, I have hereunto subscribed my name, this twenty-first day of February, one thousand eight hundred and thirty-one.

Witnesses: SETH BOYDEN.

JAMES NUTTMAN.

D. D. CRANE.

The first cupola was built in 1832. It was of the solid bottom type and used hard coal as fuel. It was a straight shaft, the upper portion of which could be lifted off for cleaning and repairs after every heat. A flaring draft stack surrounded the shaft. An archway gave entrance to the charging platform, there being ample room between the stack and shaft for the men to work. A heat could be run only every other day, the intervening time being necessary to clean out the slag and cinders.

Patterns were usually made from white metal, but iron, brass and wooden patterns were also employed. Fewer pieces were molded on one gate than at present. For one-inch buckles from four to eight were placed on a gate, but several gates were molded in one flask. The flasks were circular and made of sheet iron. The castings were cleaned in a wooden keg strengthened with iron hoops. A door at the side, iron gudgeons at the ends and holes bored to let out the sand and the tumbler was complete. Power was applied by means of a belt over the center of the keg.

Molding sand was obtained from a bank between Newark and Elizabeth. Rockaway, Long Island, furnished core sand, and the binding material was usually wheat or rye flour.

The first annealing pots were of the beehive shape, the pots being inserted from the top. A cover could be removed by means of a crane. The pots were packed in mill scale and kept at an annealing temperature for a week. An improvement upon this type was later introduced in the form of a "shove furnace," which was operated continuously by introducing the pots at one side and gradually "shoving" them through to the other. The floor was inclined to facilitate the "shoving." The furnace held 48 pots, about 10 x 12 inches, and was closed with large bungs luted at the joints. The fire-boxes were

at the side, with inlet ports near the top of the furnace. The flame passed to the upper end and then to flues below which led to a stack near the lower end. The fuel was pine wood, charcoal or soft coal.

In the early days a surprising variety of castings was made. There is a small catalog extant which states that more than 1,000 different articles were made. The prices obtained at first were about 25 cents a pound, and gradually fell to eight cents a pound in 1854. During the civil war they rose somewhat. For some time the demand for castings was almost purely local, but Boyden early managed to get foreign trade, exporting bits and other articles to Spain. The blacksmiths naturally objected to the new-fangled material and feared that it would ruin their business.

From this first malleable iron works the industry soon spread to all parts of the country. Newark became a center for annealing castings, there being at one time as many as eight foundries in operation. One of the Boyden brothers, Alex., carried the art to Boston in 1837, and a malleable iron foundry was established in Cincinnati, Ohio, as early as 1850.

The writer of this article wishes to acknowledge his indebtedness to Arthur E. Barlow, the present proprietor of this interesting foundry, and to George C. Davis, whose compilation from Seth Boyden's notes has been drawn upon freely.

The Winget Concrete Machine Co., Columbus, O., has been merged with the Cement Machinery Mfg. Co., Burlington, Ia., and the Palmer Hollow Block Machinery Co., Washington, D. C. The three companies own important basic patents for cement-making machinery. A new company known as the United Cement Machine Mfg. Co., with a capital of $1,000,000, has been formed with general offices in Columbus, and the Plain City, O., plant of the Winget company the chief manufacturing point.

FOUNDRY MIXTURES.[1]

By Bradley Stoughton.

The two important points of difference between iron castings and steel castings are (1) that the former have about 3 to 4 per cent carbon, while the latter have usually less than 1 per cent, and (2) that the cast iron has about ten

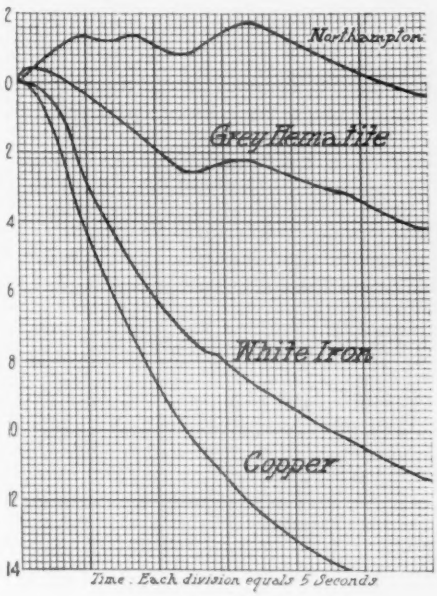


Fig. 1.—Cooling Curves.

times as much silicon as the steel. The advantages of cast iron, and the reasons it is so extensively used, are its fluidity, low shrinkage, relative freedom from checks and the ease with which we can at will confer different properties upon it. The advantages of steel are its strength and its ductility.

The amount of the combined carbon in the cast iron and in the steel varies between practically the same limits, but cast iron contains, in addition, 2.50 to 3 per cent of graphite, and 1 to 2 per cent or so of silicon. From this standpoint cast iron may be considered as high silicon steel mechanically mixed with crystals of graphite, and many of its properties are logically explained upon this basis.

---

[1]Paper read before the Pittsburg Foundrymen's Association, Nov. 5, 1906.

Shrinkage.

One of the most striking illustrations of this principle is in the shrinkage of iron castings, which averages about one-half that of steel. The difference is due to the expansion caused by the graphite, which separates out of the iron and pushes aside the particles of metal, during and immediately after solidification. After this, the metal contracts like steel, but the preliminary expansion has been such that the ultimate shrinkage is only about one-half what it otherwise would have been. We can thus control

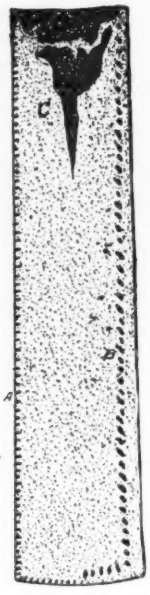


FIG. 2.—BLOW HOLES AND CONSTRUCTION CAVITY OR "PIPE" IN STEEL CASTING.

this shrinkage by controlling the amount of the expansion, through varying the graphite.

This point will be more readily understood by referring to Fig. 1, which is taken from a recent article by Professor Thomas Turner of England.[2]

Explanation of Fig. I.

The point O marks the position occupied by the end of the bars at the moment of solidification. It will be seen that in the case of copper, the metal contracts continuously from this point, as shown by the continuous drop of the curve. In the case of white iron the metal contracts continuously until we reach a certain point (which is at a temperature of about 665° Cent.) when a momentary arrest of the shrinkage takes place, after which the metal again contracts. This arrest is common to all cast iron and steel and is not related to graphite. Now see what a difference there is in the case of gray hematite cast iron, which does not shrink immediately after freezing, but expands very appreciably, as shown by the rise in the curve. This expansion is due to the

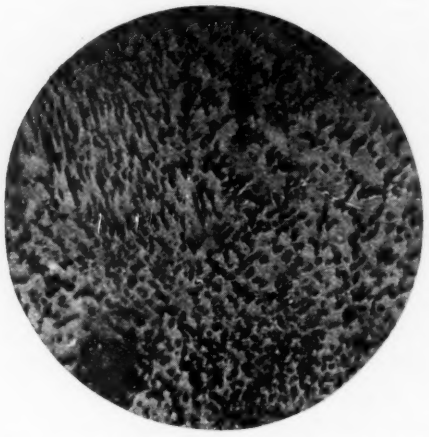


FIG. 3.—PHOSPHORUS EUTECTIC IN CAST IRON.
Magnification, 1,000 diameters.

graphite that is being expelled from the metal and occupies space between the particles of iron. Again, in the case of the Northampton iron, which is high in both silicon and phosphorus, the expansion is very long continued, and the metal cools to a temperature of almost a black heat before the bar has shrunk again to the size it had when first cast. This expansion is again due to the separation of carbon, and is assisted apparently by phosphorus keeping the iron in a semi-fluid condition for a long time and thus allowing the graphite more easily to separate and make place for itself. Here, too, we have an explanation why phosphoriferous irons fill every crevice of the molds so perfectly: Being in a pasty condition for some time, and

[2] *Journal of the Iron and Steel Institute.* No. I, 1906. Page 57.

continually expanding, the semi-fluid metal is forced into the tiniest crevices of the molds, filling all the corners with astonishing sharpness.

These explanations show why the shrinkage of the casting increases with the amount of the sulphur and the speed of cooling (which reduces graphite), and decreases with the amount of silicon which increases graphite.

Porosity.

The maximum density of cast iron occurs with 1 per cent of silicon. With more than that too much graphite separates, causing the crystals of the metal to be large and separated from each other by flakes of graphite, so that the grain is open, and water under heavy pressure might leak out (as for example in the case of hydraulic cylinders, etc.). Above 2 per cent of silicon, the grain of the iron becomes so open as to be actually porous, and the density falls off 12 per cent. With less than 1 per cent silicon the cast iron will contain spongy spots or blow holes. These spongy spots are due to high shrinkage on account of low graphite.[3]

To make a close grained iron for hydraulic work, the sulphur should be from 0.03 per cent to 0.055 per cent. If more than this, the iron is liable to be dirty, to contain spongy spots, on account of low graphite, to be difficult to machine, on account of high combined carbon, and to be weak, because sulphur, aside from its effect on carbon, greatly reduces the strength of iron as well as steel. Especially, if the phosphorus is high, the sulphur must be kept down to these limits or the iron will be hard and brittle, because phosphorus and sulphur working against each other, one increasing and the other decreasing shrinkage, make brittle iron.

Cast iron, for the same use, should contain from 0.40 per cent to 0.60 per cent of manganese. We do not want more manganese than this or the casting will be difficult to machine. We do not want less than I have indicated because manganese assists greatly in counteracting the bad effects of sulphur and phosphorus.

Phosphorus has a double-acting influence on the porosity of cast iron: (1) It increases the size of the crystals, decreases shrinkage, and causes a large expansion after solidification, as explained in connection with Fig. 1, but (2) it fills all the crevices between the crystals and in the interior of the iron, which, by decreasing the porosity counteracts its first influence. When the phosphorus is high, the phosphorus and iron form a combination known as a eutectic, which remains fluid for a long time and fills the tiniest crevices in the interior of the metal. For this reason iron for hydraulic work may run up to 0.7 per cent phosphorus, but above that, the iron is liable to be weak and "cold-short," especially under impact. In fact, where very strong iron is desired, the phosphorus should be kept down to 0.40 per cent at least.

FIG. 5.—LINES OF WEAKNESS DUE TO CRYSTALLIZATION.

With the various amounts of impurities mentioned above, the combined carbon will be in the neighborhood of 1 per cent and the graphite about 2.5 per cent, the exact amounts depending upon the thickness of the castings and the rate at which they are cooled. If we desire to keep the combined carbon the same and reduce the graphite, it will be necessary to reduce the total carbon. This can be accomplished by mixing in

[3]In the case of steel, where there is no graphite, these spongy spots actually become large open cavities, or "pipes." See Fig. 2.

steel scrap and melting very fast in the cupola, or by melting in an air furnace instead of a cupola. This reduction in graphite results in a closing of the grain of the iron, with consequent increase in strength and density.

A common cause of porosity in castings is segregation, or collection together of impurities in spots. This segregation is the greater, the greater the amounts of phosphorus, sulphur, manganese and silicon. Phosphorus increases the segregation by making a

FIG. 4.—CRYSTALS OF THE DOUBLE CARBIDE OF MANGANESE AND CARBON $(Fe\ Mn)_3\ C$.
Magnification, 50 diameters.

fluid eutectic which does not solidify until after the remainder of the casting, but then runs into that part of the metal having the loosest texture. This part is usually in the middle of the larger sections of the casting and, when the silicon is high, and there are shrinkage spots, the segregation will be excessive in the neighborhood of those spots. Manganese and sulphur are also liable to collect in the same way and place. These localities, where the segregation is high, known, when very bad, as "hot spots," are sometimes porous or surrounded by porous parts of the casting. They are sometimes so extremely hard that no tool will cut them. One way of getting rid of them is to use very large risers, or headers, which solidify last and serve as feeders to the remainder of the metal. Under these circumstances, the segregation occurs in the riser and is thus temporarily removed. This method is not advisable as a regular practice, however, because these risers ultimately find their way back into the cupola as scrap and result in increasing the impurities in a subsequent set of castings.

Headers themselves increase the density of iron castings by feeding the metal and so preventing the porous spots, and also by keeping the metal under a pressure during solidification. This latter is especially serviceable when the phosphorus is high, which tends to make the metal expand during solidification, as I have shown.

Softness, Workability and Strength.

It is the combined carbon which is the great hardener of cast iron, the other elements producing hardness chiefly in proportion as they produce combined carbon; except manganese, which not only produces combined carbon but also produces a compound having the formula, $(FeMn)_3C$, which is very hard and difficult to machine.

Silicon, by decreasing combined carbon, decreases hardness. When we get above 3 per cent silicon, however, there begin to form new compounds with silicon which make the iron hard. Furthermore, silicon above 3 per cent increases combined carbon, instead of decreasing it.

The maximum softness of cast iron is obtained with about 2.50 per cent to 3 per cent of silicon, the sulphur being not above 0.1 per cent and the manganese not above 0.4 per cent. In large or slowly cooled castings, the silicon should be near the lower limit, and in small or rapidly cooled castings, near the upper limit, in order that the combined carbon may be down below 0.15 per cent and the graphite more than 3 per cent. Such a cast iron would correspond to a soft steel, mechanically mixed with crystals of graphite. This soft steel would machine with great ease, and the graphite would act as a lubricant for the cutting tool. The mixture will have a transverse strength of about 2,000 to 2,200 lbs., be low in density and open in grain.

To increase the strength without increasing the hardness, the best way is to cut the sulphur and phosphorus down to a low point, if possible, because sulphur, and next to it phosphorus, are the impurities which weaken iron most (aside

FIG. 6.—LOW CARBON STEEL CONSISTING OF PEARLITE SURROUNDED BY CARBONLESS IRON. THIS STEEL IS EASY TO MACHINE.

from their influence on carbon). Another way is to decrease the total carbon, and hence the graphite, because graphite crystals, especially if large, are great weakeners of cast iron.

The strength of steel is more than double the strength of cast iron, the difference being due altogether to the graphite in cast iron, because silicon in itself (aside from its influence on the carbon) is a strengthener of both iron and steel up to at least 4 per cent. The way in which the graphite destroys the strength is well known to all, the broad plates of the metalloid forming planes of weakness in the casting, which easily break asunder, the graphite splitting in two, just as flakes of mica break apart, leaving one-half of each crystal of graphite sticking to each side of the fracture. This action can be proven by anyone to his satisfaction by taking a fracture of open gray iron and brushing one side of it for several minutes with a stiff brush. In this way the half plates of graphite will be brushed off, leaving a surface underneath almost of the color of white iron.

The total carbon may be reduced by melting steel scrap with the iron, or, to a slight extent, by decreasing the amount of manganese, provided that the manganese left must always be at least twice the sulphur or the iron will be weak and brittle.

The strength of cast iron may be increased by increasing the combined carbon, but this is done at the expense of softness and workability. Cast iron containing from 1.50 per cent to 2 per cent of silicon (depending upon the size of the castings and rate of cooling), 0.90 per cent of combined carbon, 0.50 per cent of manganese and not more than 0.08 per cent of sulphur and 0.30 per cent of phosphorus, will work without difficulty in the machine shop and have a tensile strength of over 28,000 pounds per square inch. In many cases, foundries are unwilling to go to the expense of such low sulphur and phosphorus. In this case the strength must be obtained by rais-

FIG. 8.—GRAY CAST IRON. Si, 1.75 PER CENT; S, 0.025 PER CENT.
Magnification, 50 diameters.

ing the manganese, which is not advisable, as it decreases the softness more than any other element, causes dull iron and high total carbon.

An important point in the connection

with the strength of cast iron is the size of the crystals of graphite. The smaller these crystals are the greater the strength, because the smaller are the planes of easy rupture. A notable example of this is malleable cast iron which may have a tensile strength of 45,000 pounds per square inch, even when the

FIG. 7.—MALLEABLE CAST IRON SHOWING THE SMALL SIZE OF THE GRAPHITE CRYSTALS.
Magnification, 50 diameters.

percentage of graphitic, or temper carbon is as high as 3 per cent. The very small size of the flakes of the temper carbon does not reduce the strength as much as the same amount of the larger graphite crystals.

One way to make the graphite crystals small is by mixing different brands of iron in the cupola. Why this should produce smaller crystals than when only one brand is melted is unknown to me, but does not change the fact, which explains why it is considered advantageous to mix brands for foundry work.

To obtain high transverse strength, the silicon should be about 0.2 per cent lower and the combined carbon about 0.2 per cent higher than the figures given for tensile strength. Otherwise the effects are very similar.

Sulphur and Manganese.

Sulphur and manganese both increase combined carbon. It is important to note, however, that sulphur and manganese form a compound with each other, having the formula MnS, and to this extent they neutralize each other and neither has so great an effect on the carbon. To form the compound mentioned, about two parts of manganese unite with one part of sulphur. If, therefore, we have just twice as much manganese as sulphur in our castings, these two elements are all used up in neutralizing each other and neither of them act so powerfully upon the carbon. It is only the excess of one or the other over the amount necessary to form the MnS which has the full effect.

The compound, MnS, is of great importance in foundry metallurgy and explains many things that have troubled foundrymen for some time. If there is more sulphur than one-half the manganese, the excess goes to form a sulphide of iron, and this sulphide of iron is very harmful in castings, greatly reducing strength and producing checks as well as "red-shortness," and "cold-shortness." It is, therefore, of great importance that there should be at least twice as much manganese as sulphur. The sulphide of

FIG. 9.—GRAY CAST IRON COOLED VERY SLOWLY, SHOWING THE VERY LARGE SIZE OF GRAPHITE CRYSTALS.
Magnification, 50 diameters.

manganese is itself bad for castings, but the sulphide of iron is very much worse. In this connection it is important to notice that iron takes up about 0.035 per cent of sulphur in the cupola and loses about 0.1 per cent of manganese, or

more if the manganese is obtained by melting spiegeleisen or ferro-manganese with the iron, so these allowances must be made in calculating the foundry mixtures.

Checking.

The time when a casting usually checks is when it is just above a black heat. It is then in a weak condition, and, as shown by Fig. 1, is crushing the sand severely. Sulphur greatly increases weakness at this temperature because both sulphide of manganese and sulphide of iron are now in a pasty condition, and, therefore, offer very little resistance to breaking. The sulphide of iron is much worse, however, because this is spread out in thin plates or membranes which offer much more extended planes of weakness than the sulphide of manganese, which is in small spots or bubbles, resembling blow holes in its effect.

Phosphorus, by decreasing shrinkage, decreases the liability of checking, but phosphorus has another influence and that is the production of large sized crystals, and in this respect it increases the liability of the metal to check. An excess of manganese over twice the sulphur will, however, neutralize, to a certain extent, the influence of phosphorus in producing large sized crystals, and will thus reduce checking.

The reason why checking is so liable to take place at the sharp corners is shown by Fig. 5, which is an exaggerated case of large size crystals, but shows how these crystals join together at corners and make a junction line of weakness along which rupture may easily take place. The size of the crystals can be decreased to some extent by chilling the sharp corners and by feeding them well. Feeding all localities liable to check has the double advantage of preventing shrinkage and segregation, both of which increase the liability of checking.

TABLE I.

Good wheel required 150 blows of 25 pound sledge to break it.
Poor wheel required 8 blows of 25 pound sledge to break it.

	Fe.	Carbon.	Si.	Mn.	P.	S.	Graphite.	C. C.
Good wheel	94.79	3.84	0.69	0.13	0.43	0.12	3.30	0.54
Poor wheel	95.00	3.52	0.65	0.12	0.52	0.19	2.35	1.17

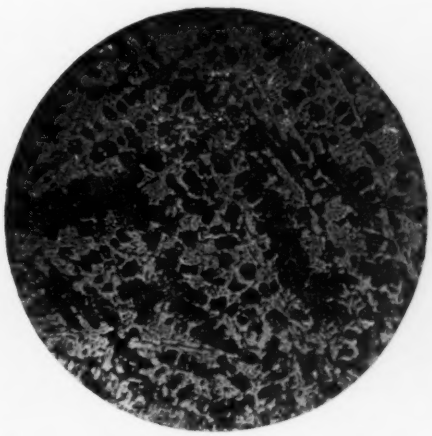


FIG. 10.—WHITE CAST IRON. Si, 0.75 PER CENT; S, 0.120 PER CENT.
Magnification, 50 diameters.

FIG. 11.—HIGH CARBON STEEL CONTAINING PEARLITE SURROUNDED BY CRYSTALS OF HARD, BRITTLE CEMENTITE (Fe_3C). CEMENTITE MAKES THIS STEEL DIFFICULT TO MACHINE.
Magnification, 250 diameters.

Comparison of a Good and a Bad Wheel.

An interesting practical test of these explanations of the properties of cast

iron was given by Mr. Asa W. Whitney in the comparison of the two wheels shown in Table I.

It will be seen that the analysis of the poor wheel does not differ enough from that of the good wheel to explain the cause of its weakness nor of the high combined carbon. Mr. Whitney figured out the chemical compounds present, as given in Table II, and this shows at a glance the cause of the trouble. Notice the large amount of sulphide of iron in the bad wheel, and that instead of soft ferrite we have the hard embrittling cementite:

TABLE II.

	Good Wheel.	Bad Wheel.
MnS	0.206 per cent.	0.195 per cent.
FeS	0.121 " "	0.315 " "
FeSi	2.045 " "	1.923 " "
Fe_3P	2.755 " "	3.335 " "
Pearlite	67.610 " "	84.492 " "
Ferrite	23.963 " "	0.000 " "
Cementite	0.000 " "	7.390 " "
Graphite	3.300 " "	2.350 " "
	100.000	100.000

Value of Shrinkage Tests.

It is well known to all foundrymen that the metallurgy of cast iron is unusually baffling because of the double and contradictory influence which so many of the impurities have, and to which I have referred above. To obtain in a given casting a certain amount of chill, or of combined carbon and graphitic carbon, or of shrinkage, etc., etc., under varying conditions of impurities, size of casting, rate of cooling, etc. is most confusing. Casting a shrinkage test bar undoubtedly aids greatly in determining the relative effect of all the varying conditions. Professor Turner has devised a very simple apparatus for making a shrinkage test which will not only measure the ultimate shrinkage of the iron, but will also show the different expansions, such as given in Fig. 1.[4]

This test will show, at a glance, not only the shrinkage of the iron but also some indication of its liability to check, its strength, hardness, combined carbon, graphite, and chilling properties, and is thus much more useful as a practical test than several laboratory tests.

[4]*Transaction* of the American Society for Testing Materials. Vol. II. 1902. Page—.
[5]This apparatus is described in the *Journal of the Iron and Steel Institute*, No. I. 1906, pages 53-54.

OPEN-HEARTH STEEL CASTINGS.—XI.

Thermit Repairs in Steel Castings.

By W. M. Carr.

Since the advent of chemistry in foundry practice there is no metallurgical invention that has proved so useful as the thermit process as perfected by Dr. Hans Goldschmidt. Its flexibility and simplicity appeal strongly to the steel foundrymen for supplying liquid steel in almost any quantity quickly and at any time. The process has been too well promulgated in the technical press to need any explanation here as to its composition and action, rather the remarks herein will relate to the methods of applying it in the practice of making repairs of the defects common to steel castings. The consideration from the foundry standpoint is mainly appearance and in this regard thermit is superior to all means, in the writer's knowledge and experience, of remedying unsightly flaws which can cause rejection without depreciating the strength.

Whether a casting should or should not be repaired with thermit will depend upon the cost of the operation. If that should exceed the molding cost, it will be cheaper to re-melt it, because the casting will always have a credit value on the basis of the market price of scrap and the loss because of the flaw will only represent the labor in molding and handling. The question of delivery frequently offsets other considerations.

Many castings are of such a size that they can be readily repaired in blacksmith's fire at a nominal cost for fuel and labor. Thermit is extremely useful in heavy, valuable castings. The commonest flaws in them are shrink-holes under-headers, sand-holes, miss-runs and cracks.

If the defect is a shrink-hole or sand-hole and where there is no machined surface, the method of filling is quite simple. There may be some grease or oil in the hole which must be removed before it can be welded. It is not always

possible to pre-heat or burn out, because the operation is slow and tedious, particularly in the case of large castings, and there may not be a large torch or oil burner convenient. The simplest way to remove the grease is to pour into the hole some loose thermit, ignite it and allow the heat of the reaction to burn out the oil, grease and dirt, which it will do most effectively. There will be a violent sputtering in the hole and a mass of slag and spongy metal. The slag can be chipped out readily. The hole is then ready for the final treatment. A gate-pin can be secured which must be larger in diameter by at least 1 inch than the hole. It should be placed over it in an upright position, and some green molding sand packed around it. Withdrawing the pin leaves a mold into which the thermit can be placed. The depth of the mold should be at least 2½ inches. When the thermit is ignited, and while burning, some loose thermit should be poured upon it for the reason that the mold will not hold in the first instance enough thermit to completely fill the hole. As soon as the action has ceased and the slag solidified the mold can be broken away together with the mass of slag. The button of metal will be white hot and as soon as it reaches a yellow or bright red it can be forged by a hand hammer. This treatment will effectively and cheaply fill any hole of the character described on surfaces that will not require machining. The button of metal will protude more or less, but it can be ground down or chipped, preferably ground.

In case such defects as just mentioned are on surfaces that may require machining, a different procedure is necessary because blow-holes must be absent from such surfaces. The same method of removing grease and dirt can be followed as in the foregoing paragraph and a charcoal or coke fire can be built over the flaw. Sand must be removed by chipping to expose clean metal. The mold must be dry sand. It can be made from a slab-core by cutting a recess or hole in it with a file. The mold must be as large in diameter inside in excess of diameter of the flaw, as in the previously described method. The mold must be carefully placed over the flaw, weighed down and the joints daubed with moist clay or dough and backed by green sand. A thermit crucible is then placed directly over the mold, charged, ignited and tapped in the usual manner. It is not recommended in this case to attempt to forge or hammer the button while hot. Let the parts cool down normally. Afterwards grind the button down flush. Grinding is better than tooling because the button, if the proper quantity of thermit has been used, will stand up some distance when the casting is placed upon a planer, the leverage of the tool is too great and there is danger of taking too heavy a cut, thus tearing the soft thermit metal out. Because of its softness it gathers under or crowds the tool and also prevents or interferes with free cutting, increases the resistance and danger of tearing. A light cut can be taken and when the button decreases in size, of course the leverage decreases, too. Should the metal be porous from any cause, or should the weld be imperfect because of an insufficiency of thermit in the first instance for welding, the operation can be repeated since thermit metal welds beautifully to the same metal and a second treatment usually satisfactorily finishes the job.

In case of shrinkage cracks, the metal must be cut away along the line of the opening to the extent of at least ½ inch or more. A mold of core material must be rammed on the casting to get the contour of the parts, allowing a mold space to form a band overlapping the edges of the opening at least ½ inch on each side of it and from ¾ to 1 inch in thickness. In welding such flaws the incoming thermit metal must enter the mold at the lowest point and overflow at the highest, using enough to get a good circulation. When cool the band of metal can be removed to the finished surface.

No fixed rule can be laid down as to the quantity of thermit to use. Usually there are no scales in the cleaning room of a steel foundry, and the operator must use his own judgment how much to use for a given operation. Practice alone

will govern and there is always the satisfaction of knowing that if a weld be imperfect from any cause it can be repeated.

All foundrymen are familiar with the well known "burning-on" of metal. Thermit practice is essentially in many details the same operation with the advantage that a "burn" can be made at any convenient time if the compound is available. The same rules will apply as in burning-on excepting that allowance must be made for a voluminous slag which always accompanies an action of thermit.

The operation of "burning-on" by ordinary liquid steel can be augmented by adding thermit to the ladle of steel taken for the purpose. An addition of 5 per cent by weight will greatly increase the temperature of the steel and of course make the operation sure because of the gain in heat.

FLUOR-SPAR AS A FLUX.

The editor THE FOUNDRY:—The correspondence in your October issue regarding the use of fluor-spar is interesting. The writer desires to make a few remarks concerning his experience with the substance. Both of your correspondents may be right but the conflicting statements arouse a desire to know the actual facts and the suggestion of Mr. Shedd that a thorough test be made to establish the validity of Messrs. Blackwell's and others claims ought to receive full endorsement.

The writer has never seen a clear, concise description of the action of fluor-spar either in a cupola or an open-hearth furnace. Only certain results have been noted without any definite theoretical explanation. If fluor-spar fuses with silica is it a fact that the combination of silica and fluorine is volatilized? If so, what is the explanation of the lime liberated acting more efficiently as a flux than an equivalent amount of lime added in the form of limestone? In other words, CaF_2 has the following percentage composition, Ca 51.28, F 48.72. The reaction between SiO_2 and CaF_2 is $2\ (CaF_2) + SiO_2 = 2\ (CaO) + SiF_4$. The product is, assuming volatilization to occur, free lime (CaO). Then 20 pounds of spar would only give 14 pounds CaO; against that, using 200 pounds limestone furnishing 112 pounds (theoretically) free CaO. In view of that fact it is hard to understand why 14 pounds of CaO from 20 pounds of spar should be more efficacious as a flux than 112 pounds of CaO from 200 pounds limestone, the quantities named by your correspondents as the amount of each substance to use in a 6,000-pound charge of iron.

The writer some years ago was employed in a Bessemer steel works laboratory when low sulphur stock for the cupolas was scarce. Nothing but high sulphur stock was available. It was important to keep the sulphur within certain limits and numerous trials were made with fluor-spar with a view to desulphurizing. It was put through the cupola with the charges and also used in the ladle after the steel was blown. No definite results followed in regard to the sulphur. The most pronounced effect was the cutting of the cupola linings. After thorough trials and experiments were abandoned.

There can be no doubt about the value of fluor-spar as a flux but more light is certainly needed concerning its desulphurizing properties.

Messrs. Blackwell & Sons Co. mention it being used extensively in basic open-hearth practice for the elimination of sulphur. Possibly they may have in mind English practice. There is certainly no analogy between cupola melting and open-hearth melting (basic) in regard to desulphurizing. In one case there is a silicious slag and the other a calcareous one, both diametrically different; one with no affinity and the other with an affinity for sulphur. In America, the writer can state authoritatively that it is not depended upon in basic open-hearth melting as a desulphurizer. The question of desulphurizing is one of the basic melter's least troubles. The function is purely one of a basic slag,

one highly charged with lime, and such slag does desulphurize effectively without any assistance from fluorspar. It is a common occurrence to charge pig iron into a basic open-hearth furnace with as high as 0.08 per cent S. and with the proper amount of limestone, finish the heat with 0.025 per cent and less of sulphur, no spar being used. Many basic heats are produced to which not a pound of spar has been added. The main purpose of spar in basic practice is when the slag may be heavy, sluggish and does not thin well, a dose of a few shovels of spar will liquify it completely. It is rarely necessary to use more than 35 to 40 pounds per heat. With a charge of metal carrying 10 per cent and more of limestone the addition of a minute quantity, comparatively, of spar cannot add sensibly to the slag's basicity. All progressive melters are chary in the use of spar because a too liberal use of it will cause severe cutting of hearth at slag line and a heavy consumption of refractories to repair the same. Its value to a steel melter is great indeed to promote desirable slag fluidity but it is only used at a time when a slag has reached its full content of lime and the desulphurizing has fully progressed before the thining action of the spar is utilized.

Trusting these remarks may be of interest to your readers and that you can accord the writer some of your valuable space.

Faithfully yours,

W. M. GRAHAM.

EARLY FOUNDRY PRACTICE.

In this day of activity and progress we, the younger generation, are apt to think that we are making strides with "seven league boots," but our pride is not proof against falling when it is learned that some practices today regarded as "fin de siecle" were in vogue forty years ago.

Not long ago the writer was in conversation with an old foundry foreman now retired. He told of his experience in the foundry in the early fifties. The discussion was on "semi-steel" and the supposedly new idea of purifying cast iron by certain methods. He went on to describe the early practice of melting wrought iron with a charge of pig iron in a cupola, how the difficulty in getting uniform metal was avoided by having one inch bars of wrought iron sent to a blast furnace where they were placed in the pig beds and gray iron cast around them. In this way the wrought iron forming a core of the pigs overcame the irregularities in melting encountered with the first attempts. Castings made from such mixtures showed good finish and strength and compared well with the "semi-steel" of today.

Another plan was followed, which today would be considered foolish. When it was desired to cast such parts as cylinders, free from kish and dirt, it was the practice to stick an Irish potato on the end of a bar and plunge it into a ladle of molten iron. The effect was to agitate the metal, bring to the surface dirt, slag, etc., and, it was stated, with an apparently decided gain in fluidity. Castings poured after such treatment were finer grained and machined free from dirty spots. The method was not costly and was certainly just as effective as some processes and methods advocated today which are bolstered with more or less theoretical and scientific claims.

The saying that there is "nothing new under the sun" may be trite but modern research and knowledge have certainly assisted to relegate to the background the old-time foundry foreman or cupola tender who carried under his hat the mysteries of mixing and melting cast iron.

DUD DUDLEY.

The Straub Machinery Co., Cincinnati, has been organized with a capitalization of $300,000 by Orville simpson, Lewis H. Allen, Elmont H. Spooner, Paul Nacher and Frederick Gerton. A large machine shop and foundry will be erected on Knowlton street, the plant covering some four acres.

METALLOGRAPHY APPLIED TO FOUNDRY WORK.—VI.

By Albert Sauveur.

The microstructure of cast iron free from combined carbon and therefore containing the totality of its carbon in the graphitic condition was briefly described in the last instalment of this article. It was shown, that, as might have been expected, the metal

Fig. 1.—Gray Cast Iron. Combined Carbon .10 Per Cent. Not Etched. Magnified 100 Diameters.

was made up of a mass of carbonless iron or ferrite containing numerous plates of graphite of very irregular shape and size and so distributed through the iron as to very effectively destroy its continuity, thereby weakening it and depriving it of its ductility, malleability and weldability.

The concluding remarks are reproduced below by way of introduction to the subject to be considered in the present and following instalments.

"The foregoing considerations suggest three means of increasing the strength of gray cast iron free from combined carbon: (1) by reducing the amount of graphite carbon, (2), by decreasing the size of the graphite particles and (3) by regulating the shape of the graphite particles, causing them to occur as rounded grains rather than as curved plates.

"The amount of graphitic carbon (which here means the amount of total carbon) can be decreased by the use of steel or other low carbon metal in the cupola, or by oxidation in the 'air furnaces.'

"The size of the graphite particles is undoubtedly greatly influenced by the rate of cooling of the castings during solidification and subsequent cooling, and this in turn is affected by the size of the castings. It is probably true that the slower the cooling during solidification and subsequent cooling the larger the graphite particles.

"In the references which have been made here to the rate of cooling it has been supposed that the cooling could in every case be conducted so as to preserve the whole of the carbon in the graphitic condition. As is well known, however, a slight acceleration of the cooling will often suffice, even in the presence of a large amount of silicon, to cause the formation of some combined carbon, the iron then ceasing to be perfectly gray and acquiring properties due to the presence of combined carbon, which will be considered in our next instalment.

"No means have yet been devised for regulating the shape of the graphite particles which form during the solidification and cooling of gray cast iron, but it would be hazardous to affirm that no heat treatment or other manipulation can ever be found which would accomplish this end.

"Very few castings, if any, are produced absolutely free from combined carbon, nor are they generally wanted because of their lack of strength, but it was desirable to start our description with the structure of such cast iron because it forms the first link of the chain uniting cast iron free from combined carbon with cast iron free from graphitic carbon, the various links of which are to be described in these articles."

We may now pass to the examination of the structure of cast iron containing increasing amounts of combined carbon. I shall for the present ignore the influence of phosphorus, sulphur and other impurities upon the

structure and properties of cast iron. In other words, I shall consider cast iron as an alloy of iron and carbon containing the necessary amount of silicon to produce in the casting the proportion of combined carbon indicated. In doing this I propose to lay a foundation into which we may later on weave the influence of impurities and other factors.

Between cast iron absolutely free

FIG. 2.—GRAY CAST IRON. COMBINED CARBON .10 PER CENT. ETCHED. MAGNIFIED 100 DIAMETERS.

from combined carbon and cast iron free from graphitic carbon, there exists numerous grades of cast iron containing all the way from 0.1 per cent or even less to 3 per cent or more of combined carbon. By gray cast iron, however, is meant an iron which does not generally contain more than 1 per cent of combined carbon. With a higher percentage of combined carbon the iron is called mottled. These mottled irons form the connecting link between gray iron and white cast iron and it will be shown later that a sharp line of demarkation may be drawn between gray iron and the mottled variety while, of course, the passage of the mottled into white cast iron is indicated by the disappearance of graphite. According to the appearance of their fracture cast irons have been from time immemorial classified as Nos. 1, 2, 3, 4 foundry, etc., graphitic carbon decreasing and combined carbon increasing as we pass from No. 1 to No. 4. But let it be borne in mind that the appearance of the fracture depends not only upon the chemical composition but also upon the rate of cooling and therefore also upon the size of the casting. A cast iron which after very slow cooling or in the shape of a large casting would be classified, from the appearance of its fracture, as No. 1 foundry, might after more rapid cooling or in smaller castings be classified as a No. 3 or a No. 4 foundry or indeed might be converted into a white cast iron. It follows from this that the classifying of cast irons by analysis is a much more logical and scientific method.

Microstructure of Cast Iron Containing 1 Per Cent Combined Carbon.

Figs. 1 and 2 show the microstructure of a sample of cast iron containing but a very small amount of combined carbon, respectively before and after etching. Before the etching treatment only the graphite particles are brought out, as usual, the background appearing uniformly bright. After etching, however, the presence of another constitutent having a dark mottled appearance is revealed. By comparing it to the structure of cast iron free from combined carbon it will be seen that here again the metal is made up chiefly of a mass of ferrite mixed with many plates of graphite. It will be noticed, however, that many small dark areas now occur in the ferrite and since we know that ferrite is free from carbon it naturally follows that all the combined carbon present must be located in these small areas. It is also known that the combined carbon in iron exists in the shape of a carbide of iron Fe_3C which in metallography is called cementite. We might, therefore infer quite naturally that the dark areas are particles of this combined carbon or cementite. By using a higher magnification however, it is found (see

Fig. 3) that each one of these dark particles is in reality made up of two components assuming generally the shape of parallel plates. As to the nature of these components it is evident that one of them is the carbide Fe_3C while the other must necessarily be iron or ferrite for the simple reason that to the best of our knowledge it cannot be anything else. Dr. Sorby, who was the first observer to describe the appearance of this interesting constituent, proposed for it the name of "pearly constituent," because it frequently exhibits a display of color very suggestive of mother of

FIG. 3.—GRAY CAST IRON. COMBINED CARBON .10 PER CENT. ETCHED. MAGNIFIED 500 DIAMETERS.

pearl. Later on, Professor Howe proposed the name of "pearlite," a term which has been universally adopted. Pearlite, then is a mechanical mixture of ferrite and cementite after the fashion described in the preceding paragraphs, i. e., occuring in parallel plates alternately of ferrite and pearlite. The characteristic structure of pearlite is further clearly illustrated in Fig. 4 to the exclusion of any other constituent.

It should be stated here that pearlite does not always assume a distinctly laminated structure; in many instances its structure remains ill defined, assuming a granular rather than a lamellar appearance. It will be shown at the proper time that this is due chiefly to the treatment to which the metal has been subjected and we find in this another evidence of the

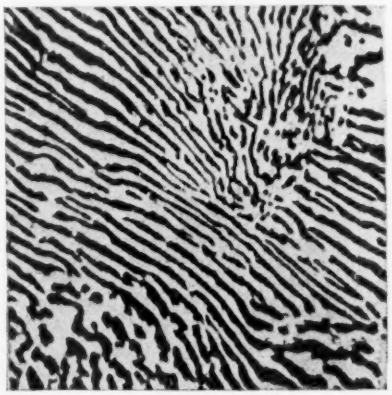


FIG. 4.—PEARLITE. MAGNIFIED 1,000 DIAMETERS.

close relation existing between the structure of iron and its treatment. A high magnification is required for the resolution of pearlite, generally not less than 200 diameters. The samples should also be very carefully etched.

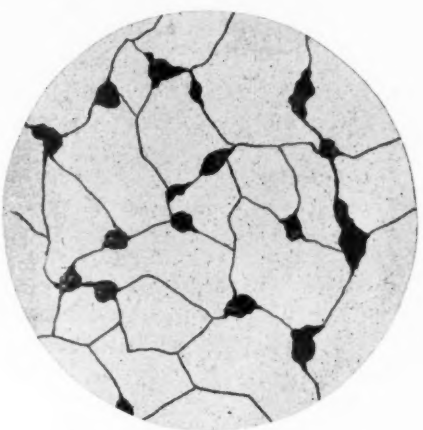


FIG. 5.—LOW CARBON STEEL. CARBON .08 PER CENT. (DRAWING AFTER ARNOLD.)

From this examination of the structure of cast iron containing a small amount of combined carbon we therefore obtain the interesting informa-

tion that, contrary to what might have been our expectation, the combined carbon is not evenly distributed through the iron but that like graphite it is also segregated in the shape of many small irregular particles and mechanically mixed with a certain amount of ferrite.

In figures 5, 6 and 7 is shown the structure of steel containing nearly the same amount of combined carbon and it will at once be apparent that the structure of the steel is very similar to the metallic part of gray cast iron or in other words, that the only

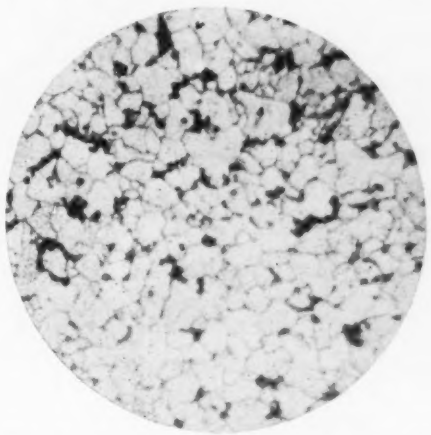


FIG. 6.—LOW CARBON STEEL. CARBON .10 PER CENT. MAGNIFIED 100 DIAMETERS.

FIG. 7.—LOW CARBON STEEL. CARBON .10 PER CENT. MAGNIFIED 1,000 DIAMETERS.

difference between the two metals is to be found in the presence of graphitic carbon in the gray cast iron. Could we remove the graphite from the gray cast iron we would evidently convert it into a low carbon steel and vice versa the introduction of graphite flakes into the steel would convert it into a gray cast iron.

A very close analogy therefore between cast iron and steel is thus clearly brought out and it is well to insist upon this point because of the very generally prevailing belief in a wide difference between the two metals. Foundrymen are prone to look upon cast iron as a metal so different from steel that any information obtained as to the constitution of the latter or as to its treatment is of no value in the case of cast iron. It will be one of the aims of this article to emphasize the close relationship between cast iron and steel and to show how the recent searching investigations into the nature of steel may be applied with fruitful results to the study and treatment of cast iron.

Notwithstanding their great similarity of structure, however, the samples of cast iron and low carbon steel here illustrated, differ very widely in physical properties; the cast iron whose structure is exhibited in Figs. 2 and 3 would probably not have a tensile strength exceeding 10,000 pounds per square inch, would have practically no ductility and would be neither malleable nor weldable, while the steel shown in Figs. 5, 6 and 7 would have a tenacity of some 55,000 to 60,000 pounds per square inch, a ductility of 25 or more per cent and would be malleable and weldable.

It is evident that this enormous gap in their properties is due to the presence of numerous particles of graphite in the gray cast iron which are so distributed as to destroy the continuity of the metallic mass.

If we compare the gray cast iron of Fig. 2 with the structure of cast iron free from combined carbon illustrated in the last installment, we find that

while the latter had a matrix of the nature of wrought iron the former has a metallic body of the nature of a low carbon steel and just as low carbon steel is stronger than iron free from carbon we should expect cast iron with a little combined carbon to be stronger than cast iron free from it. By increasing the strength of the metallic matrix of cast iron we naturally increase its strength as a whole.

It will be seen therefore, that the introduction of a little combined carbon into cast iron has acted precisely in the same manner as the same amount of combined carbon introduced into iron, the change resulting chiefly in increased strength, and slightly decreased softness. In the case of steel it also decreases somewhat the ductility, but with cast iron, since this metal is practically deprived of ductility, that property cannot be greatly affected.

In subsequent instalments we shall examine the change of structure and properties due to an increasing amount of combined carbon.

COKE SAMPLING FOR FOUNDRIES.

CLYDE MYERS.

The following method of sampling, single car-loadings in box cars, will be found to give an accurate average of the car of material.

Take a piece of boiler plate, or other flat iron, 3 feet square (more or less) make a bottomless wooden boxing, with ten-inch sides to set on iron, and have an iron stamper with 4½-ft. wooden handle for crushing down the coke.

When the car door is opened, go over the exposed top of load, and take eight *whole* pieces from different parts of the car.

After the middle is unloaded out, take four whole pieces, from each exposed side, and again when car is nearly unloaded, take four whole pieces from each end of the car.

Throw these pieces on the iron, and crush down to the size of peas, or smaller, then thoroughly mix together with shovel, flatten out pile, and mark out in quarters, throwing away opposite quarters, again thoroughly mix with shovel, and again quarter down, throwing away opposite quarters, and continue quartering down until about two quarts remain. Again quarter, taking up two opposite quarters in sack or can, for chemist, and save the remainder, for check analysis, if necessary.

Whole pieces are specified, because they give the entire section of the coke from the top to the bottom of the oven.

The coal, when charged into the oven, begins burning from the top downward, and when the process is completed the pieces of coke stand vertically in the oven, so that the whole pieces from top to bottom, give a complete average of the varied structures as well as the chemical content of the coke.

Unless the sampling is properly done so as to give a correct average, the money paid out for chemical analysis is wasted.

Chemical determination for ash should be burned off slowly, too rapid burning may form a slag, which will not come down to a proper determination. Also the residue should be tried at least three times for constant weight by being put on the flame a second and third time, as frequently an ash apparently burned off will lose more weight on further burning.

Large samples should be taken, the larger the sample the more correct will be the result.

If broken pieces are sampled, great care should be taken to get the proper proportion, of "tops," "middles" and "bottoms" to maintain a correct average. Six times as much "middles" as combined "tops" and "bottoms" would give as correct an average as any general rule that could be applied.

However, unless the sampler is very familiar with the structure of the different sections of coke, the much safer and at all times more correct method is to sample whole pieces.

There is none so wise as the man who knows nothing. His ignorance is the height of impudence, yet he settles matters as if all wisdom were only known by him.—*The Obermayer Bulletin.*

FERRO-ALLOYS.[1]

By A. E. Outerbridge, Jr.

The use of ferro-alloys in the foundry is likewise extending. The simple method first described in the address given before the metallurgical section of the Institute a year ago for softening iron for castings to any desired degree has been continued, with exceedingly beneficial results.

The speed of turning pulleys has been largely increased and the time required to complete the machine work upon them has been reduced, and in other light castings as well. In addition to the material improvement in the strength of the metal by this treatment, there is a decided decrease in the shrinkage, so that some castings of irregular shape which are difficult to make without cracking in cooling, owing to unequal strains, are now made without this tendency by this process. Other advantages accruing from the addition of a very small amount of high grade ferro-silicon (containing about 50 per cent of silicon) have been observed. Among these may be mentioned the cleaning action upon the molten metal which the alloy effects by its deoxidizing influence. Singularly, also, it is found that commercially pure silicon does not produce these results, neither does the ordinary grade of ferro-silicon, containing about 20 per cent of silicon.

Fig. 1. Fig. 2. Fig. 3. Fig. 4.

Fig. 1 shows the fracture of two test bars cast from a ladle of untreated iron. The upper piece was cast in green sand, 1 inch by 1 inch by 15 inches, and was an ordinary transverse test bar. The lower piece was cast in a heavy iron cup in order to very rapidly cool the metal. The upper test piece is perfectly gray and easy to drill. The lower one is perfectly white and cannot be drilled with an ordinary steel drill.

Fig. 2 shows the fracture of two similar test bars poured from the same iron after addition of 0.3 per cent of silicon in the form of high grade ferro-silicon (50 per cent Si.) added in the ladle. Note the marked reduction in depth of chill in the sample cast in the iron cup.

Fig. 3 shows the fracture of two similar test pieces from the same iron after adding 0.5 per cent silicon in the ladle. The "chill" is still further reduced.

Fig. 4 shows the fracture of two similar bars from the same iron after adding 0.8 per cent silicon in the same manner. The chill in the sample cast in the iron cup is amost entirely absent.

The samples cast in sand are all perfectly gray, but there is an appreciable difference in the fracture, the treated metal showing softer iron than the untreated sample.

The metal selected for this particular test was comparatively low in silicon, consequently having comparatively high chilling property, but this fact would never be suspected from an examination of the fracture of the test sample cast in sand. Very few practical founders are aware of the large variation in chilling property of their iron, sometimes of presumably similar grades, melted on different days, or even of the wide variations which may occur in different portions of one heat. The chill cup test here shown is an invaluable

[1]Extract from a paper read before the Franklin Institute, Philadelphia, Pa.

instructor in this matter, and without its aid the beneficial effects of adding high grade ferro-silicon to molten cast iron could not have been so readily detected and exhibited. These chill magnifiers have been used with great benefit in daily practice more than twenty years. They are far more effective than the ordinary chill tests made in car wheel foundries. Such tests are only applicable for very high chilling iron, while the cup tests here described are only intended for use with comparatively low chilling irons.

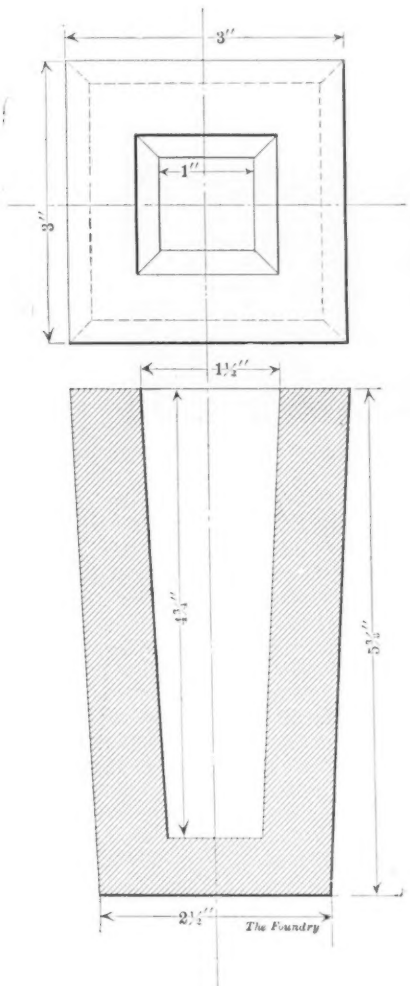


FIG. 5.—CUP FOR CHILLING TEST BARS

In the case of pure silicon the specific gravity of the material is too low and its melting point too high to permit it to become incorporated with the molten iron in the ladle, in the other case the proportion of silicon is too low to permit a sufficient amount to be dissolved in the iron to produce a radical change in its quality without causing dull iron in the ladle.

There is no doubt but that when the merits, simplicity, certainty of action and other advantages of this process of treating molten iron in the ladle are better known and appreciated it will come into very extensive use, for it enables the founder to modify the character of his iron to suit individual castings, a matter of considerable importance and value. This is accomplished without expense, for the cost of adding silicon to the iron in this manner is actually less than by the usual method of adding an equal amount of silicon to the iron in the form of pig iron, comparatively high in silicon, added in the cupola. For example, pig iron containing six per cent of silicon costs at the present time, let us say, $22.50 per ton, and we may estimate for comparative purposes $3.75 per unit of silicon; ferro-silicon containing 50 per cent of silicon costs at the present time in powdered form $100 per ton, or $2 per unit of silicon on the same basis of calculation.

Furthermore, there is no loss of silicon when added in the ladle, as there is when melted in the cupola, and this partly accounts for the fact that a given quantity of silicon, when added in the ladle, is much more effective as a softener than the same quantity charged into the cupola. Silicon added in the cupola always weakens the iron, while silicon added in the ladle always strengthens it.

The Milton Machine & Foundry Co., Milton, W. Va., has been organized with a capital of $5,000 to buy, sell and manufacture machinery and oil well supplies, conduct a general repair shop, etc. The incorporators are: T. L. Morris, E. E. Dubbing, R. T. Neel, R. E. Thornbery and J. T. Graham, of Huntington.

NEW BOOKS.

Elementary Practical Metallurgy of Iron and Steel, by Percy Longmuir. New York and London. Longmans, Green & Co. 5 x 7½ inches. 270 pages. Cloth. Supplied by THE FOUNDRY for $1.60.

The author states in the preface that the work is designed to serve as an introduction to the metallurgy of iron and steel, and as such, has been written from a practical standpoint. So far as possible, he has remained within the data obtained from his own experience. The work is illustrated with a large number of drawings, diagrams, half-tones, and tables. As stated in the beginning, the work is elementary in its nature and is not intended that it should be a treatise on the subject. Some of the chapters treat of the following subjects: Refractory materials, fuels, iron ores and their treatment, the blast furnace, the general properties of cast iron, remelting cast iron, malleable cast iron, wrought iron, the crucible process of making steel, the open-hearth process. The work contains a great many useful suggestions and much food for thought. It is a valuable book to place in the hands of any man who desires an elementary knowledge of the subjects treated.

Foundry Practice, by James M. Tate and Melvin O. Stone. Minneapolis, Minn. The H. W. Wilson Co. 5½ x 8 inches. 334 pages. Cloth. Supplied by THE FOUNDRY for $1 50.

This book was written primarily for the use of the students of the University of Minnesota. It was intended to take the place of lectures ordinarily given by the instructor in foundry work; hence is elementary and general in its character. For anyone who wishes to gain a knowledge of the underlying principles of foundry practice the terms used, the machinery and equipment employed, etc., this work will be found valuable. There are many practical examples of molding, including various classes of green sand, dry sand, and loam work. The subject of molding machines is treated briefly, as is also the various other pieces of foundry equipment. Under the subject of melting, both the cupola and air furnace are treated. There is a separate chapter devoted to brass foundry practice. In the back of the book is a glossary of foundry terms, and also a number of useful tables.

The Steel Square as a Calculating Machine, by Albert Fair. New York. The Industrial Publication Co. 81 pages, illustrated. 5 x 7½ inches. Cloth. Supplied by THE FOUNDRY for 50 cents.

This is a book which presents a number of problems to be solved graphically by the medium of the steel carpenter's square. It is written in elementary fashion for the use of apprentices and beginners, although it contains information that will prove of value to the journeyman worker.

TRADE PUBLICATIONS.

The Narragansett Machine Co., Providence, R. I., has issued a novel catalog, which is of standard size, 6 x 9 inches. This is a 32 page catalog describing the lockers and similar equipment manufactured by this company. The front cover is embossed to represent a locker door, and the various details of the metal lockers are fully illustrated, also various styles of wooden lockers, seats and stools in connection with lockers and other similar equipment.

The Joseph Dixon Crucible Co., Jersey City, N. J., is sending out a standard size publication, 6 x 9 inches, containing 84 pages, and entitled "Graphite as a Lubricant." This is the tenth edition which has been issued under the same title, and it has been revised and considerable new matter added. The fact that the previous editions have been very gladly received by all interested in the subject shows that the pamphlet must contain matter of value. Many of the tests described and much of the general information contained will be found of specific use to any one having machinery of any kind either to look after or to care for. The average engineer will also be very much surprised at the many uses to which graphite can be put and the saving which can be effected by its use.

THE PATTERN SHOP

A FOUNDRY RIG.

By Thomas Mack.

The accompanying illustrations show a convenient sweeping rig, to which may be attached various strike boards, the striking edge of which contain radial sections of the pieces to be swept up. As the strike boards are rigidly and permanently secured together with cleats they can be attached to or removed from the rig very quickly as the case may require, no special adjusting being necessary. The advantages of the rig can readily be seen, for if a casting is to be duplicated all that is necessary is to go to the pattern storage, get the strike boards, and attach them to the rig.

The blocks B-B, upon the cleats which secure the boards together guide the parts into their correct position upon the rig.

The rig is shown as applied to the sweeping up of a green sand mold for producing a dome casting, as shown in half section and half elevation in Fig. 1. The assembled arrangement of the rig with the strike boards attached is shown in Fig. 2. At the right of the spindle the operation of sweeping the exterior form of the dome is shown in progress. Upon this sweep surface the cope is subsequently rammed up. At the left of the spindle the rig is shown in the reverse position or upside down, as

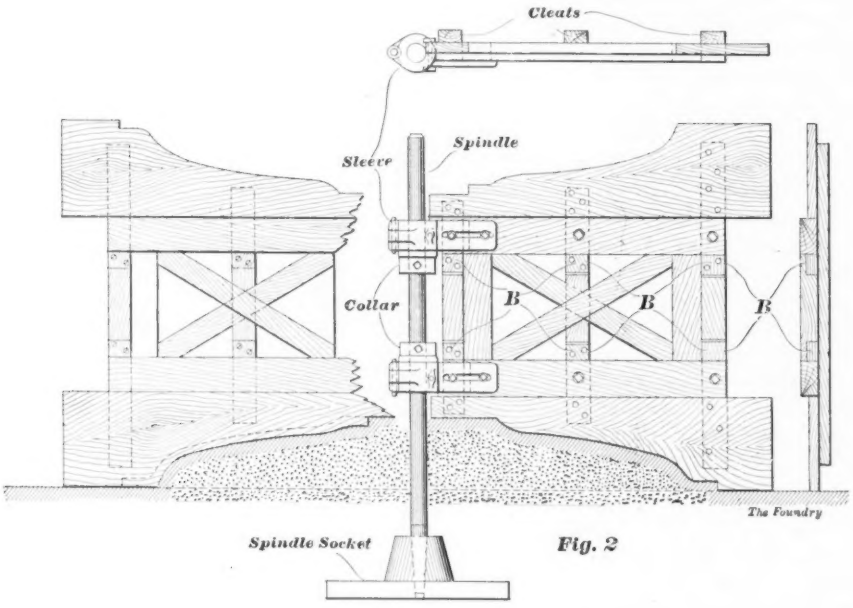


Fig. 2

when set for sweeping off the metal thickness or striking up the interior form of the dome. Of course, the striking up of the interior form takes place after the ramming up and lifting off of the cope.

The separate parts of the arrangement are shown in Fig. 3. The rig itself is shown at the left, and consists of a rigid frame made from 3½ x 1½-inch material, the frame being strengthened by cross braces, as shown. The spindle

sleeves are of the hinge design, as this form of sleeve allows the rig to be attached to or detached from the spindle without disturbing the latter; that is, the spindle can be set up and adjusted and the rig attached afterward. The sleeve is shown in greater detail above the frame. At the right of Fig. 3 are shown

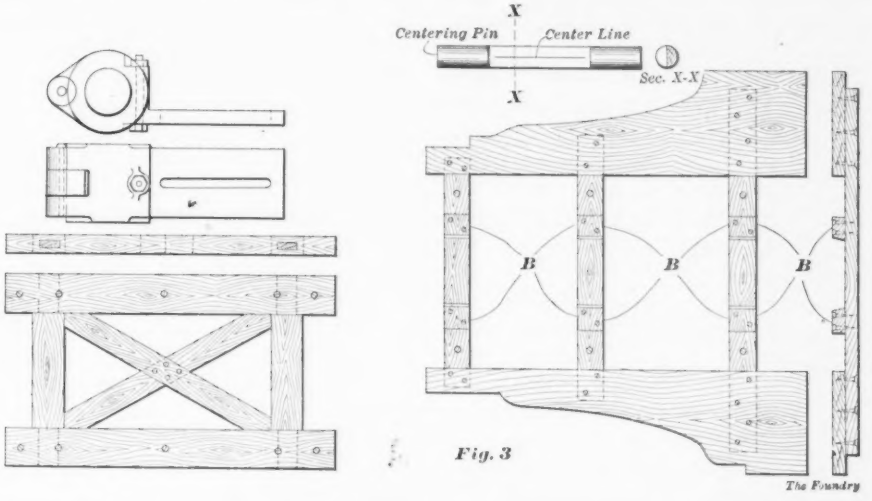


Fig. 3

the strike boards as they would appear when removed from the rig. Care should be taken in attaching boards together to see that they are rigidly secured to the cleats with screws and a spot of glue at the extreme ends of the cleats. There are two advantages in this manner of gluing. First, any shrinking or swelling that may take place in the boards will be toward or from the glue spots at the ends

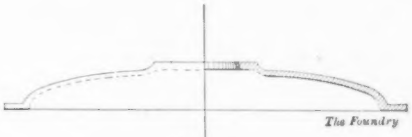


Fig. 1

of the cleats and will prevent the striking edge of the boards being distorted. Second, if glue was applied to the portion of the cleats extending across the boards, warping of the boards would be the result. In fitting the boards to the frame the latter is laid down and the boards with the striking edge dressed to form, placed in about their correct position and the cleats attached. Next the centering pin shown directly above the striking boards in Fig. 3 is used in locating the blocks B-B, Figs. 2 and 3. These blocks should be securely fastened in place with glue and screws. The centering pin is usually turned up from well-seasoned hardwood, its diameter being the same as that of the spindle. A portion of the center is cut out to half the diameter and the center line of the pin scribed thereon. By shoving the pin through the sleeves as if it were the spindle and turning the flat side of the pin into the plane of the striking boards, the center line upon the pin becomes immediately available for setting the boards.

THE RELATIONS BETWEEN THE MOLDER AND PATTERN MAKER.

By Knapp Leon.

In a previous issue of THE FOUNDRY an article appeared, treating at some length the feeling existing between the two crafts. The particular quality of the feeling does not at first appear, but later one gathers that it is an ill feeling,—one of antagonism. To the initiated the reasons are too obvious to require an explanation, being almost entirely due to the different conditions under which each labors and the natural effects of these conditions upon him, as evidenced by the ease with which apprentices are

acquired in one trade and the difficulties encountered when seeking to fill one's quota in the other.

Let us consider the conditions under which each enters upon his trade.

The average boy going into the pattern shop has had the benefit of at least a common school education, and has arrived at an age when it is time for him to choose his future occupation. He arrives at the factory, clad in a fairly neat suit of clothes, and is provided with a locker to keep them so. His work room is usually light, well ventilated and heated. His tasks are light and agreeable, and of such a character as to keep him interested and further develop the educational training which he has received at school. At his work, and between that and his home, he can be, and usually is, a neat, well-appearing, self-respecting boy.

The Contrast.

The foundry apprentice usually becomes such because of the pressing need at home for the money he can earn. With him it is not often a matter of choice, but rather of necessity, as is also the case with the firm who hires him, and it is largely from boys of this class that molders are recruited. On his entrance to the foundry, he stands blinking until his eyes become accustomed to the semi-darkness, and is soon taken in tow by the "Boss," who turns him over to a molder, saying, "Bill, here's a new boy for you. See that you keep him busy."

He hangs his coat and hat on a nail at the back of the floor, exposed to all the smoke and dust, and is at once introduced to a shovel and told to cut over a sand heap that looks (to him) as large as a suburban trolley car. This done, he helps Bill to carry in his mold board, which is heavy enough for two men, and while Bill gets the pattern ready, he bravely struggles, picking his way over a poorly-cleaned gangway, with a wheelbarrow load of facing heavy enough for a husky Pollack.

He then moves a ton or so of clamps to find a No. 2 riddle which is buried under them (for safe keeping), bruising his thumb-nail and skinning his knuckles during the process,—Bill meanwhile yelling at him to "hurry up and get that sand riddled." "Now mix a bucket of clay wash"—and in so doing he decorates his trousers and shoes and complicates the color scheme of his countenance. Bill keeps him hustling to fill the flask while he rams it, nearly breaks his back striking off the drag, chases him off after clamps to hold the flask and boards together while it is being rolled over, then swings the poor, antiquated jib crane over to the flask, hitches on the chains and yells, "Hist!" The boy turns the crank, which in its upper position is almost out of his reach, until the strain of the load comes on, when he realizes that it is beyond his strength and that he is "stuck." In response to Bill's yell of "Hey, there, what in H-l are you doing? Why don't you hist it up?"—he renews his efforts, gets the crank over a half a turn, his feet slip, he loses his balance, the load gets away from him and the crank throws him over on to a pile of gaggers. While he sits there trying to collect his wits, with the laughter of Bill and the "boys" ringing in his ears, the whistle blows for the noon recess and he rises and hunts around for a place to wash up.

He sees Bill and the others performing their ablutions, each with a bucket of water resting on the floor, for this comprises the wash room of the average foundry. After Bill finishes he uses his bucket and tries to remove the dirt from his hands and face, (a part of the trade that only long practice brings to a successful issue) grabs his dinner pail and seeks a place where he can eat his dinner. He timidly joins Bill and the others, who are seated on bottom boards and riddles around the red-hot stove, which is the only comfortable place in the foundry at this time of day. As they proceed to eat, with their dinner pails between their knees, "Mickey the Bo," relates, with much unction, how he beat his way from Chicago to San Antonio, and struck a job in Tom Gaff's on big work and made a sixty-foot fly wheel without a pattern, making all his own rigging, etc.; how it took him three days to melt the iron and when they cast it a man with a lighted torch rode around

the mold on horseback, touching off the vents, etc. Then "Reddy" tells of the trouble he once had with a gear wheel pattern that the d-d patternmaker had drafted the wrong way. This tale brought forth a number of experiences along similar lines, in each of which the "stuck-up" patternmaker was wholly to blame, "didn't know how to make a sash weight pattern, etc."

The one o'clock whistle breaks up the dinner party, but not until it has given the boy his first impression of the status of the patternmaker in the estimation of the molder. A few moments later the boss comes along and says: "Hustle and get that cope rammed up today, Bill. I'll have to put French Joe on with you tomorrow so that we can cast it. The Old Man's in a hurry for it, and I want you to be ready for first iron, too." As he goes off, Bill growls,—"Yes, make me hustle and do all the hard work, and then send French Joe over to help me do the easy part. I'll bet five dollars they didn't hurry the patternmakers! You can't hurry them, they always take all the time they want, but the minute the pattern gets to the foundry, it's hustle, hustle, hustle!" Frequent reflections of this kind have their influence on the boy's mind and he soon grows to regard the patternmaker with jealous envy. As he is occasionally sent to the pattern room on errands, he notices the contrast between the shop conditions. The sight of the workmen sitting at their work, or perhaps several of them grouped around a drawing trying to determine the best method to be used in making the pattern so that it will be economical to mold, convinces him that perhaps Bill was right in saying that "You couldn't hurry a patternmaker."

So the boy, who goes home from his work at night with aching joints and muscles, knowing that his life must be spent amidst the hustle and bustle of the dirty, gloomy foundry, very naturally feels that in many ways he will always be considered the inferior of the (to him) more fortunate patternmaker, and the seed of envy is by this time very firmly rooted in his heart. The boy from the pattern room, meeting this disreputable figure, with his torn and dirty clothing, regards him with scorn. This does not tend toward any better feeling on the part of the embryo molder and gives him a very bitter taste, which only years can obliterate. If he is the right kind of a boy, (and it is regrettable that there are not more of that kind in the foundry) as he advances in years he becomes better acquainted with his "enemy," and learns that it is not all as Bill and "Reddy" said, and that patternmakers, as a rule, study to turn out work that will mold well; also that they are pretty good fellows, always ready to give and take with the molders who show a disposition to do the same, and that they are often qualified to give sound advice as to the best method to be used in casting certain work.

The difficulties encountered by the foundryman who seeks to fill the ranks of his apprentices with bright, energetic boys who come from good families and are graduates of our grammar or high schools, can hardly be appreciated by managers in the allied trades, who almost always have a waiting list. With the possible exception of a few recently-built modern foundries, where the molder's comfort and convenience have been considered, and where modern equipment has been installed to relieve him of much of the real labor, allowing him more time in which to use his skill and brain and gaining thereby for his employer greater production, our trade can hardly be said to offer many attractions to boys of the above class.

Believing, as I always have, that no trade today holds better opportunities for boys who are determined to "get there," and are willing to work to that end, and appreciating the vital necessity of elevating the personnel of the trade. I have sought by every method, in various places, to get boys of this kind. I have called often upon their parents and set forth the advantages, over many others, of our trade, explained the need of better education in the high places, etc., but regret to say that so far my efforts have met with but indifferent success, most parents refusing to allow their boys to go into the foundry. They give as reas-

ons, that the work is too hard and dirty, that their clothes would scent the whole house, and, finally, that the molders are such a tough lot that they cannot have their boys exposed to their bad influence, etc. This is largely a case of "giving a dog a bad name," for the day of the drunken and obscene molder is fast disappearing, as it is only when badly rushed that any one will hire him, and it only needs the concerted persistent efforts of our manufacturers and the various foundrymen's associations to remove the obstacles that have so long stood in the way of getting desirable boys to learn the trade. This can be done by offering them a somewhat higher wage rate than is usually paid in the more attractive trades, cleaner, lighter and better ventilated shops, ample locker rooms for their clothing, and a pleasant room with tables and chairs or benches where those who desire may eat their lunches like "white men." A few trade journals would provide profitable employment after lunch for such as cared to read, while others could forget their troubles in a friendly game of cards, or perhaps discuss some shop problem over a well-filled pipe.

When the molder can go and come to and from his work looking and feeling as respectable and care-free as other mechanics, and labor under as good conditions, that day will (in the writer's estimation) "bury the hatchet," so far as the molder is concerned, between the molder and the patternmaker.

The Clarksville Foundry & Machine Co., Clarksville, Tenn., has been incorporated with a capital stock of $25,000 by Graham MacFarlane, Guy R. Johnson, Q. C. Atkinson, E. T. Ancher and H. L. Leech.

The Bergen Foundry, Union and Sackett streets, Jersey City, N. J., has been incorporated to manufacture castings, hardware, machinery, etc. The capital stock is $50,000, and the incorporators are: Edward E. Stowell, 5 Nassau street; Romeyn Berry and John T. Brent Second, 135 East Thirty-fourth street, all of New York city.

THE DEVELOPMENT OF A SCREW PROPELLER FROM THE PATTERNMAKER'S STANDPOINT.

By Carl H. Clark, S. B.

The present article concerns the development of the propeller blade from the known dimensions and the putting it into such shape that the pattern may be made from it. It will, therefore, be presumed that these dimensions of diameter, pitch and developed area have been decided upon, as this is the work of the marine engineer.

The principle upon which this work depends is the fact that one convolution of a screw or helix may be unrolled into a right angled triangle, one of the sides of which is equal to the pitch, and the other side equal to the circumference of the cylinder on which the helix is formed; the angle formed by the hypothenuse is then the angle of the screw at any point. This is shown in Fig. 1, where the distance OA represents the pitch and OB the circumference; the diagonal line AB then shows the angle of the helix. Applied to a propeller, the distance OA is the pitch of the propeller, OB is the radius x 6.28, and the diagonal AB gives the angle of the blade at the tip. For convenience, OB is made equal to the radius, or $\frac{\text{circumference}}{6.28}$ so that OA must be made equal to $\frac{\text{pitch}}{6.28}$

It will be plain that for any other points, as those chosen, the angle of the blade may be obtained in the same way.

Turning to Fig. 2 the outline C-D-E-F-G represents the "expanded" blade, and is very nearly the outline that would be obtained if a sheet of paper were laid on the face of the actual blade, the outline transferred, and the paper flattened out. The distances OC-OD-OE-OF then represent the true widths of the blade from the center line at these points. The points o-o-o-o may be chosen whenever convenient, but should, preferably, be evenly spaced, and must, in any case, be the same in the several views.

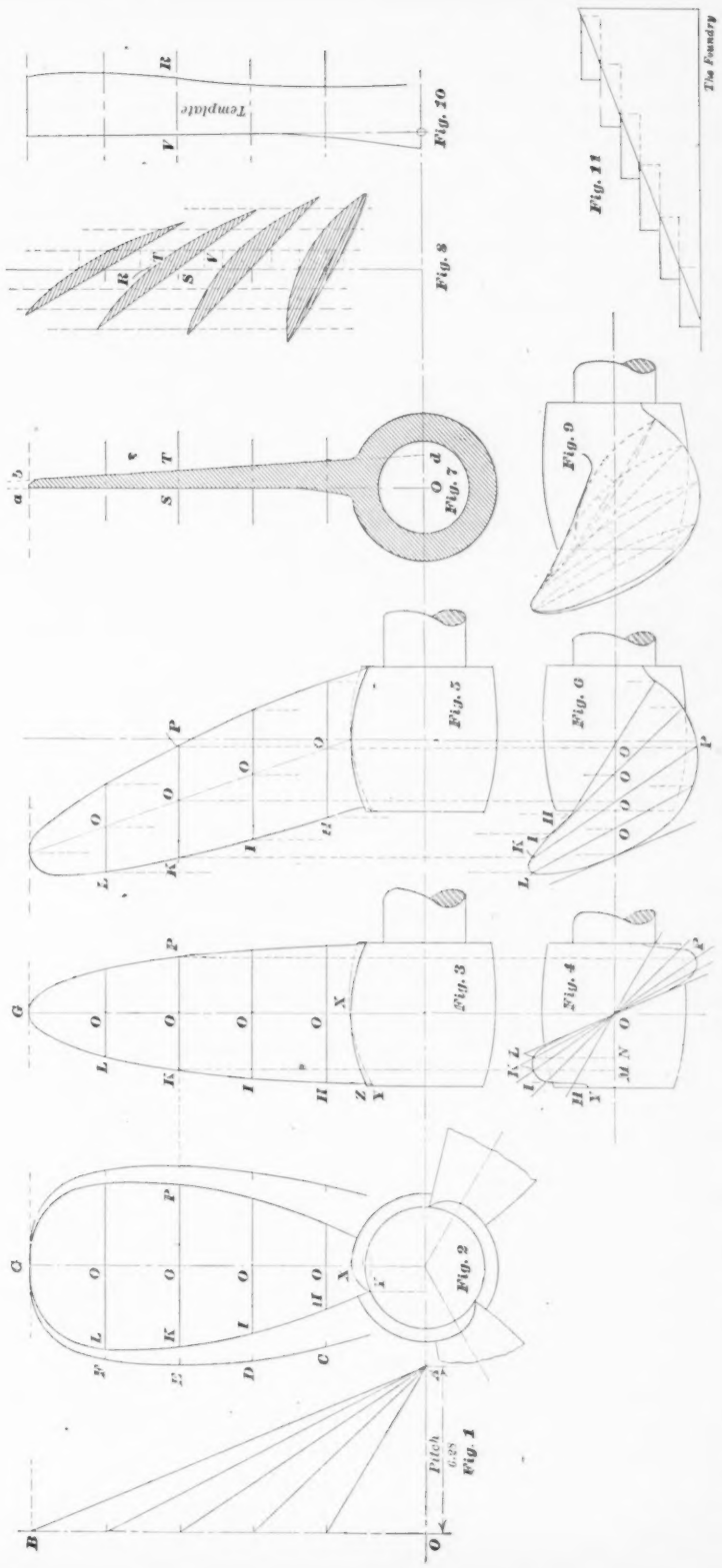


Fig. 10
Template
R
V
Fig. 8
R
T
S
V
Fig. 11
The Foundry
Fig. 7
a
b
v
T
S
O d
Fig. 9
Fig. 5
P
O
I
H
Z
K
Fig. 6
P
O
H
K
I
L
Fig. 3
G
P
O
X
L
K
I
H
Z
Y
Fig. 4
K L
M N O
H
Y
Fig. 2
G
P
O
X
L
K
I
H O
F
E
D
C
Fig. 1
Pitch
6.28
B
O

Fig. 4 is the end view of the blade, looking directly down upon it. The horizontal lines of Fig. 2 will appear in this view at their proper angles, as given by Fig. 1, and as the blade is erect they will all cross at the center line; this view also shows all breadths of the blade in their true size. The true breadths from the expanded blade are now laid off in Fig. 4 from the center O on the proper pitch line, OF to OL, OE to OK, OD to OI and so on, giving the outline H.I.K.L., which comes in tangent to the pitch line of the tip. The other side of this outline is obtained in the same manner, the half breadths being taken from the other side of the expanded outline; when the expanded outline, as in the present case, is similar on both sides, the two portions of the outline of Fig. 4 will be the reverse of each other.

The outline H.I.K.L., of Fig. 2, is the view of the blade, looking along the shaft. It is obtained from Fig. 4 by taking the projected distances MK, NL, etc. from the center line out to the several points, and laying them out from the center line in Fig. 2 on the proper pitch line; thus, MK. would be laid off to OK and NL to OL and the other points in the same way giving the outline H.I.K.L.G. The other side of Fig. 2 is obtained from the opposite portion of Fig. 4 in the same manner.

Fig. 3 is the side view of the blade, looking at right angles to the shaft, and is simply the vertical projection of Fig. 4. The several points, H.I.K.L. of Fig. 4, are then projected vertically up on to the proper pitch line, as is shown for the points K. and P., giving the outline H.I.K.L.G., Fig. 3.

Returning to Fig. 3 the hub is drawn in as shown. The end view of the hub in Fig. 2 appears as two circles, the larger through the point x being that of the greatest diameter and that through YZ being the circle of the after face.

The outline H.I.K.L., Fig. 2, is prolonged downward from H until it cuts the circle of the after face of the hub at Y; this point, then, is where the blade intersects the hub. The point Y is projected across onto the after face of the hub in Fig. 3 at Y and the outline carried down to it. The horizontal distance from Y to the center line in Fig. 2 is laid off from the center line in Fig. 4, giving the point Y in this view. The other edge of the blade is finished in the same manner.

The curved line X to Y in Fig. 2 is the line where the surface of the blade cuts that of the hub; looking at Fig. 3, the left side of the blade outline is beyond the center line, while the right side is nearer the eye; this causes the line of intersection XY to be dotted, as it is on the further curve of the hub, while the corresponding line for the right side, being on the nearer curve is full and the outline of the hub is dotted behind the blade

Considering that Fig. 2 is a view of the after face of the wheel, looking forward, it will be plain that to drive ahead the blade must turn toward the right; this is the definition of a right handed wheel. The edge containing the point P is called the leading edge, as it is the edge which first meets the water, and the edge H.I.K.G. the following edge. If a left hand wheel were desired, the distance OA, Fig. 1, would be laid off to the left of O and the pitch lines would make the same angles on the opposite side of the vertical. This would, of course, make the pitch lines of Fig. 4 slope in the opposite way, and reverse the slant of the projected blade in Figs. 2 and 3. The details of the work would, however, be the same.

It should be remarked that for the present purpose of illustration the several views have been unnecessarily separated, in practice Fig. 1 would probably be drawn over Fig. 2 and Fig. 4 put on the same center line as Fig. 3.

The blade so far considered has been vertical with the shaft, consequently all of the pitch lines pass through the center O, Fig. 4. The blade shown in Figs. 5 and 6 has its center line canted back so that each pitch line crosses the center line at a different point. The points o.o.o.o. in Fig. 5 are projected down on to the center line in Fig. 6, giving the corresponding points o.o.o.o. The pitch angles from Fig. 1 are now

drawn, in Fig. 6, each through its proper point. The distances OK-OL-OP, etc., are laid off as before from the expanded blade outline. The outline will come in tangent to the pitch line at the tip as in the other case. Fig. 5 is the vertical projection of Fig. 6; the several points are projected vertically up on to the proper horizontal line in Fig. 5, giving the outline H.I.K.L.

It is evident that the fore and aft projection of this blade is the same as that of the upright blade so that Fig. 2 will serve as the projection of both blades.

The considerations thus far relate simply to the working face of the blade, without regard to the necessary thickness. Fig. 7 is a diagram showing the blade thickness at the center line for all points. It is not, of course, a true section, as, the thickness being measured at right angles to the surface, any true section would have the same twist as the blade. It is laid out in this manner simply for convenience; ab is the thickness of the tip and od the thickness the blade would have if it extended to the center line; the line db being a straight line near the root a part of the thickness is added on the face in order to avoid the excessive roundness of the sections near the hub which would occur if all of the thickness were put on the back. The tip is rounded off to a sharp edge at the working face. Fig. 8 shows the sections at their proper angles and their true shape; the length of each section is the same as that of the expanded blade outline and the thickness is that of Fig. 7, thus the thickness ST, Fig. 8, is the same as ST, Fig. 7, and is laid off from the center line at right angles to the face of the blade; the back of the section is very nearly a circular arc. It will be noted that on the lower section the face also is slightly curved, as before mentioned. These sections are drawn thus in the present case for convenience; as a rule they will be drawn one over the other, as in Fig. 9. A curve drawn in tangent to the outside of all of these sections will give the outline of the back of the blade, as in Fig. 9, which shows the complete blade. This completes the actual work of projection on the blade.

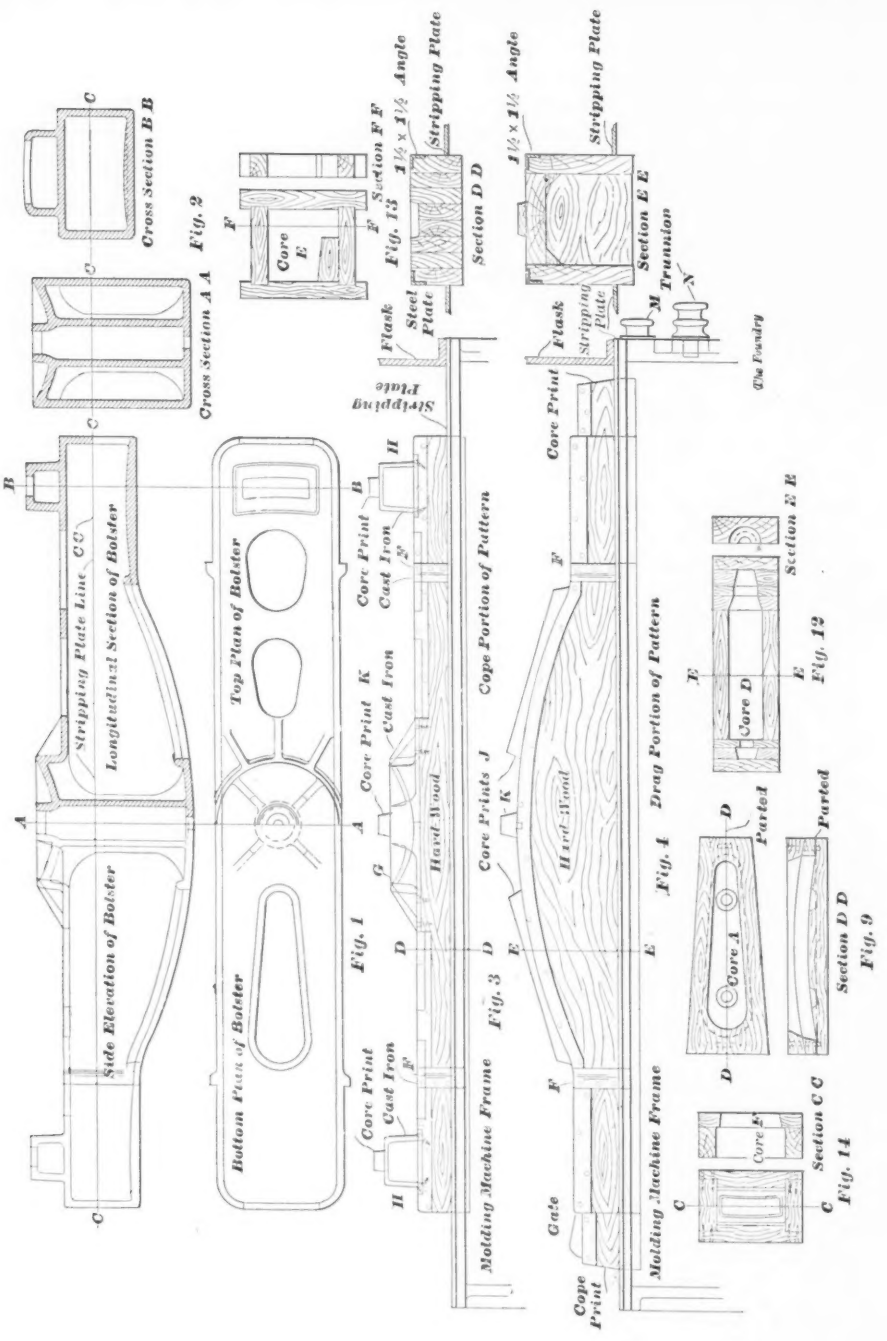
To prepare for the pattern either Fig. 8 or Fig. 9 is used. The stock runs lengthwise of the blade; the dotted vertical lines are spaced off each side of the center line at a distance apart equal to the thickness of the stock to be used. It will now be seen that to cut the slice of the section between R and V a width of stock will be needed equal to that of the rectangle between the dotted lines at R and V; this distance is then laid off in Fig. 10 at RV. The same is done on the other sections including the tip, and the curved outline is obtained, this is the shape of the piece of stock necessary to form this lift of the blade. Every lift will of course be of a different shape, but it is customary to take the largest as a pattern for all. The center O of these lifts is marked.

To set up these lifts to the correct pitch a sheet metal template is made as in Fig. 11 to the angle of the tip from Fig. 1 and bent to the radius of the blade. The several templates are pivoted together on their centers and swung around until the corner representing the working face of each is even with the edge of the template; this gives them the correct angle for the pitch. The remainder of the work of trimming, laying out the outline and fitting to the hub has no features uncommon to ordinary pattern work, and need not be considered in the present article.

MOLDING CAST STEEL TRUCK BOLSTERS.

By H. J. McCaslin.

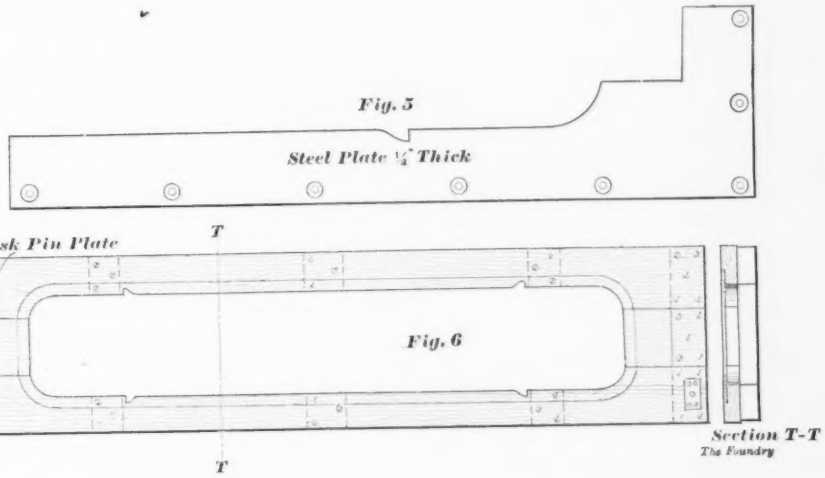
The truck bolster shown in the accompanying illustration is that of the American Steel Foundries and the drawings also show their method of molding it. Green sand molds are employed in the production of practically all of this class of work. This is true whether the bolster pattern be mounted on a stripping plate machine, as in the case under discussion, or be molded upon the floor. The method of molding is comparatively simple, but affords a very good example of the ramming up of a green sand core in place. This operation may be



applied to very good advantage in a great variety of ways, especially in the producing of light steel castings where the presence of dry sand cores is to be avoided if possible, owing to their tendency to retard the shrinkage, as this shrinkage is apt to result in a badly strained or cracked casting when resisted by hard cores. This method may save some of the expense otherwise incurred in the making up of dry sand cores and in the handling of the same.

The success of the patternmaker in dealing with any problem of this kind depends wholly upon his ability to see how the object or pattern to be made will appear and how it may be molded in the most practical manner. With these two points constantly held clearly in mind the construction of the pattern becomes a secondary consideration. For this reason the writer believes that large returns often result from time spent over a drawing in studying every detail and getting a thorough idea of what is desired by the draftsman and what is required in the way of material, etc. When beginning any pattern, whether it is to be mounted on a machine or molded on the floor, its position and manner of molding must first be determined. The truck bolster to be molded is shown in several views in Figs. 1 and 2. At the top of the illustration, Fig. 1, is shown a half-side elevation and half-longitudinal section on the center line of the bolster. At the bottom of the figure is shown a half-top and half-bottom plan, while Fig. 2 shows two cross sections of the bolster on the lines A-A and B-B, Fig. 1. The section A-A gives a cross section of the bolster at the middle through the center plate, while a section through the side bearings is shown at B-B. The stripping plate line or the line of the parting is located at C-C, Figs. 1 and 2.

In beginning the work, let us first take up the construction of the cope and drag portions of the pattern, as shown in their mounted position upon the molding machine, Figs. 3 and 4. These parts should be made of hard wood, maple preferred, although in some cases pine is used. The parts should be substantially put together and the corners protected by light angle iron as shown. Fig. 3 illustrates the cope portion of the pattern, which, owing to its shallowness, is usually made solid, the material being glued up edgewise, as shown at the right in the cross section of the pattern on the line D-D. This section is taken through the depression in the pattern which forms one of the openings in the top of the bolster. In other words, these openings in the top of the bolster are depressed in the pattern to a depth equal to the metal thickness of the top of the bolster. These depressions or openings thus form their own green sand cores during the operation of molding.



Temporary patterns are made for the center plate G, side bearings, H and guide flanges F, these parts being made of cast iron fitted or turned up and subsequently properly located and secured in position upon the pattern.

The drag portion of the pattern is shown in Fig. 4. The construction of this portion is that of the box section as shown at the right in the cross section on the line E-E. The two ends of the pat-

tern are practically built in solid, to allow for the forming of the core print at each end. In constructing this portion of the pattern the sides may be gotten out about 2½ inches thick, laid off, sawed and dressed to form. This portion of the pattern, as well as the cope portion, should extend about two inches below the stripping plate line. After the two sides have been placed upon a level surface and squared up, they are secured together with separating pieces and the two ends filled in solid. The top is next filled in and dressed off to conform with material forming the stripping plate. In most cases a steel plate about ½-inch in thickness is used, but the writer has fitted up molding machines for this class of work with a pine stripping plate about 1¾-inches in thickness, the lumber being substantially cleated together, and has found that such stripping plates have successfully withstood the action of pneumatic rammers in the production of several hundred castings. If it is determined to equip the machine with a half-inch steel stripping plate, the pattern is located and secured in its correct position

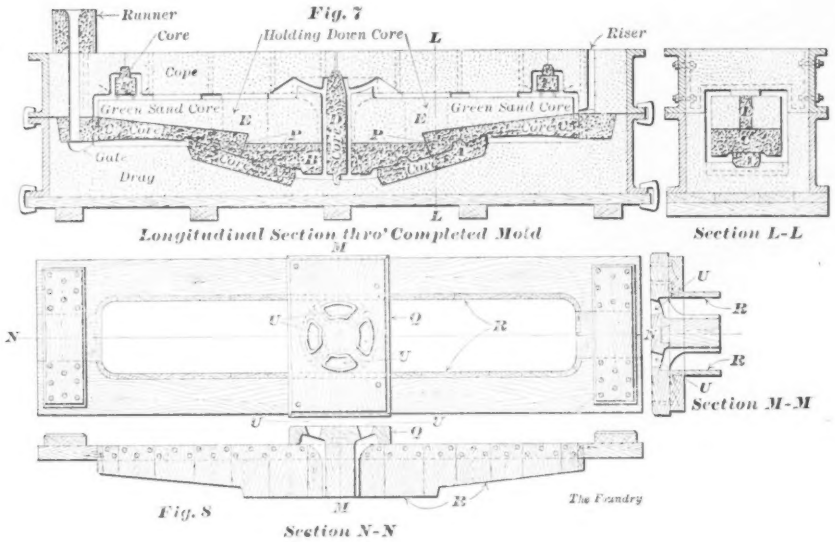


Fig. 7

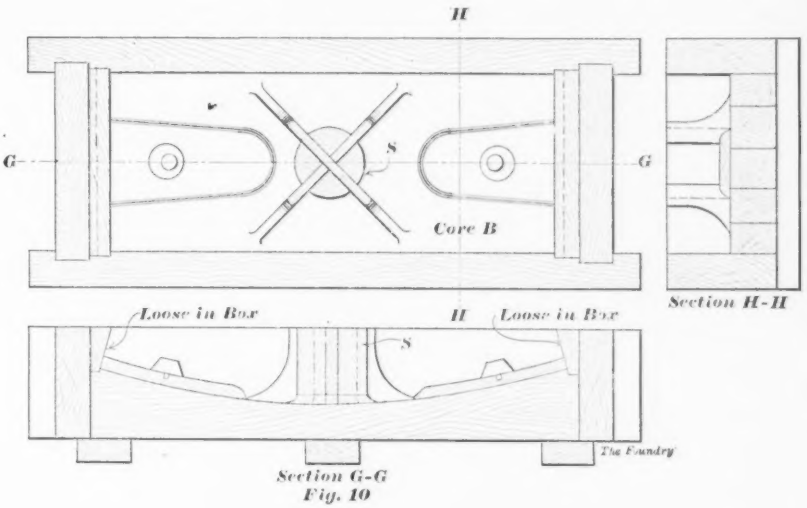
Fig. 8

the sides. As the two oblong openings in the bottom of the bolster are formed by a dry sand core with a core print setting, these two core prints J are gotten out and secured in position as shown, as is also the center pin core print K. With the binding of the corners of the pattern with angle iron and the securing of the guide flanges F in position, this portion of the pattern is completed, after it has had the usual application of shellac.

As the mounting of the pattern upon the machine depends entirely upon the raising and lowering operation and the arrangement of these parts of the machine we will not discuss that part of the work, but proceed with the fitting on of the upon the operating device. A wooden templet is next gotten out and fitted up to the pattern. While in this position the outer edges are dressed off to conform to the outer edge of the flange of the frame, also the longitudinal and cross center lines are laid out, as the plates must meet at these points. One of the quarter plates is illustrated in Fig. 5. These plates, which are gotten out in four pieces, or in other words, are punched and chipped to the outline of the templet, after which they are secured to the flanges of the side frames of the machine with countersunk head screws. The center line of the pattern is next carefully tried for exactness and the templet for drilling the flask pin

holes applied. This operation should be very carefully conducted, as the matching up of the cope and drag portions depends entirely upon the care with which it is performed. Should a wooden stripping plate be desired, material equivalent in length and width to the top of the side frame flanges may be cleated together in a temporary manner and the pattern placed in its correct position upon it. With a small pair of dividers set to about

tention is next given to the matching up of the cope and drag portions of the mold. The most satisfactory manner of ascertaining this fact and detecting any discrepancy is to have two or three castings made and check them up carefully. The making and checking of one casting is not always reliable, as a little variation in the flask pins may make it appear as if the setting up of the machine was not correct.



Section G-G
Fig. 10

1-16-inch a parallel line is next scribed around the pattern. The cleates are then removed and the material enclosed by the scribed lines sawed out. Permanent cleates are next applied and the whole secured together. To protect the edge of the opening and to insure a closer joint around the pattern without a large bearing surface, 1½-inch by ⅛-inch band iron is laid in around the opening, as shown in the plan and elevation, Fig. 6.

The pattern having been secured to the machine, the plate or top is set down over it and secured to the side frames with bolts. Plates containing holes to receive the flask pins are now located by the aid of the flask pin templet as previously stated, these plates being let down flush with the top surface and secured with screws as shown.

With the machine fitted up, our at-

The drag portion of this pattern is mounted upon a roll-over machine, that is, a machine which is inverted with the flask in place and the pattern subsequently drawn up out of the sand, this being necessary on account of the fact that no bars are used in the drag flask and hence it cannot be lifted off and rolled over. The attaching of the flask to the machine of course changes the center of gravity of the machine. For this two trunions are required, as shown at the right of Fig. 4, the fixed trunion M being employed when inverting the machine with the flask attached, while the attachable trunion, N, which is secured to the end frame with a pin and socket, as shown, is used in returning the machine to its upright position when the flask has been detached.

With everything in readiness we will now proceed with the molding of the drag portion of the pattern. The pat-

tern is first raised and locked in position as shown in Fig. 4. The flask is placed on and securely clamped down to the flange of the machine, a thickness of prepared sand is applied over and tucked around the pattern. The balance of the flask is filled with heap sand, which is rammed in, the top being struck off in the usual manner. A bottom board is next applied and clamped down, and this is followed by the rolling over of the machine and the drawing of the pattern as previously described. The next

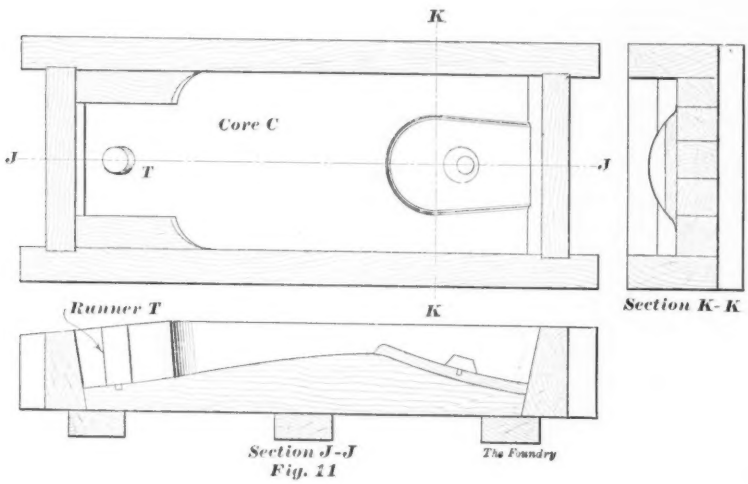


Fig. 11

operation is the setting of the several dry sand cores which form the metal thickness or bottom member of the bolster. Before proceeding further it will be well to study Fig. 7, which shows the manner in which these different cores are placed together in the mold. In setting the cores, the cores A, which form the two oblong openings in the bottom of the bolster are first placed in the depressions left vacant by their respective core prints J. It will be observed that these two core prints J are provided with projections P, which might be termed dowels. These serve to locate and secure the center core B in its correct position and also one end of each of the cores C, the outer ends of the latter mentioned cores being received by a core print setting as shown. When these five cores have been located, the holding-down cores E are placed in position, directly underneath or opposite the depressions in the cope pattern which form the openings in the top members of the bolster, as shown in the cross section of the mold on the line L-L, Fig. 7.

These two cores E are rammed up in the green sand core and are used to prevent the dry sand cores at the bottom from rising, due to the pressure of the metal exerted underneath the cores as the mold is poured.

The method of ramming up the green sand core is illustrated in Fig 8. It will be noticed that there is a frame used for ramming up the green sand core, the construction being made clear by the illustration. The center part Q which contains the center post and vertical ribs of the bolster is made detachable and secured to the frame with dowels, this being done to allow this part to be drawn first, so that the top of the green sand core may be slicked and dressed up before removing the frame proper. The core is constructed as follows: After the dry sand cores are set, as already explained, the frame without so as to rest upon the parting. The material R passes down into the space terial R passes down into the space over between the wall of the mold and the dry sand cores as shown by the dotted lines in Fig. 7, thus closing up this space and preventing any sand falling

into it during the ramming up of the green sand core. The center part Q of the frame containing the center post, etc., which passes down into the depression in the core B is also located. The depression in the core B is formed by the material in the core box shown in Fig. 10. The openings U are to facilitate the ramming of the sand underneath the top portion of the frame. After the sand has been rammed into the green sand core frame the top portion Q is removed, the surface slicked up, and then the other portions drawn away so as to leave the green sand core in place.

As the molding of the cope pattern shown in Fig. 3 is of a simple nature and embraces no special points of interest, we will proceed to discuss the construction of the core box employed in forming the various cores. Fig. 9 shows a plan and cross section of the core box used in forming core A, which gives its construction and the manner of parting. In Fig. 10 is illustrated a plan longitudinal and cross section of the core box used in forming the center core B. It is in this box that the portion of the center post, with its ribs, is formed by the material S, the remaining portion being made up in the green sand core as explained previously. Within this box is also placed a portion of the reinforcement around the oblong opening, the remaining portion being placed in the core box shown in the plan and cross section in Fig. 11. This latter box is employed in forming the two end cores C, which are identical, with the exception of the runner T, which is rammed up in one core only. The center pin core D, the holding-down cores E, and the side bearing cores F are formed in their respective core boxes, as shown in Figs. 12, 13 and 14.

TRADE PUBLICATIONS.

The S. Obermayer Co., Cincinnati, is sending out a folding post card containing a return mailing card, which is very neatly gotten up. As the card comes directed it reads on the face "It's just like handing you money," with a suitable picture opposite the legend. Beneath is the address of the party to whom it is sent. Upon opening it proves to be an advertisement of the Rockwell riddle, showing the stiffening pieces used for supporting the rim. One flap of the card is a return postal card which can be used for ordering a supply of the riddles, or for quotations of prices on the same.

The Fox Machine Co., Grand Rapids, Mich., has made some very marked improvements in its Universal wood trimmers. These improvements are described in the standard size catalog 6 x 9 inches, known as Bulletin No. 49. One of the special devices described in the catalog is a new triangle gauge, used for cutting various irregular forms. This is fully illustrated and described. Another exceedingly useful device and one which is novel in its construction is the attachment for cutting segments for three, four, six, eight and twelve sided figures. The table of the machine has laid out upon it certain lines and graduations which enable the workman to set the gauges so as to produce true segments of any desired style or size. The segment stop used in connection with this arrangement is a patent device and will certainly be found a great time saver. In connection with the segment cutting device there are furnished some copyrighted tables showing its use. The machine is also fitted with a new device for taking up the wear of the sliding knife head. By this mechanism it is possible to prevent any looseness in the sliding knife which is ordinarily occasioned by wear. At the same time the original perpendicular position of the knife is preserved. This important feature will be appreciated by all users of machines of this type.

The Nernst Lamp Co., of Pittsburg, is issuing a small catalog, 4½ x 6 inches, entitled "The New Pennsylvania Terminal, New York City," which contains some interesting matter concerning the terminal and also concerning the lighting of the same by Nernst lamps.

BRASS FOUNDING

THIS DEPARTMENT IS DEVOTED TO THE TREATMENT OF ALL ALLOYS INCLUDING THEIR

FOUNDING, GRINDING, POLISHING, ELECTROPLATING ETC.

PLANT OF THE AMERICAN BRASS WORKS.

We have had inquiries in THE FOUNDRY from time to time as to the advisability or possibility of operating a foundry on the second floor of a building or on any floor above the ground floor. The work of an ordinary brass foundry is no more dangerous than the work of the tool tempering department or many other departments of a modern metallurgical or manufacturing plant, and if proper precautions are taken there should be no additional fire risk in placing this department on any floor of a building.

The plant of the American Brass Works, which is owned and controlled by the Murdock Mfg. & Supply Co., of Cincinnati, O., is a splendid example of this. This foundry is located on the third floor and the location gives it a number of advantages. The building is four stories in height in front and three stories in the rear. This brings the brass foundry up under the roof, where it can have a sky-light and ample ventilation. This is a decided advantage in hot summer weather. The brass furnaces are situated in a large steel tank, which is suspended in an opening in the floor. This tank is sup-

MOLDING FLOOR IN FOUNDRY ON THE THIRD FLOOR.

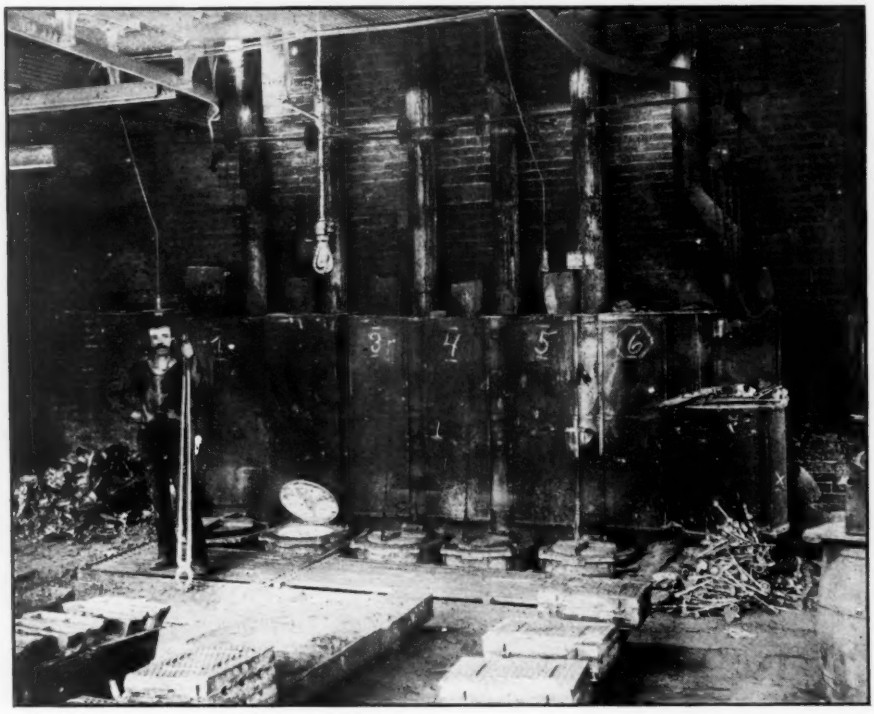
ported on steel beams and separated by an air space from the rest of the building. The foundry floor is an ordinary wooden floor, covered with a layer of concrete, then with a layer of sand, and next with an ordinary brick floor. Five ordinary crucible furnaces are arranged in the pit mentioned, and a sixth one, used for emergency work, is placed above the floor at one side of the pit. The waste heat from the furnaces is utilized for heating a series of core ovens.

The foundry is equipped with one Tabor molding machine and a number of tubs for bench work. Nine or ten men are ordinarily employed. For handling the metal when large castings are to be poured a trolley system is arranged which encircles a portion of the floor and runs over to the brass furnaces. This trolley serves either for handling large molds or for metal for them. As one visits this plant he is impressed with the fact that the foundry is simply a department in the manufacturing con-

THE BRASS FOUNDRY IS ON THE THIRD FLOOR OF THIS BUILDING.

cern, for as one steps through the door of the foundry room proper into the manufacturing department the first thing encountered is a water mill for grinding the skimmings.

The cleaning department, with its metal band saws, spruce cutters, etc., is also in this room and beyond are situated the various machines for turning and finishing the brass castings. This is as it should be, that is, the metallurgical process is made simply a portion of the work of the plant.



MELTING FURNACES WITH CORE OVENS BACK OF THEM.

The plant formerly owned and operated by Deyoe & Guylee, at Poughkeepsie, N. Y., has been sold to W. Wagnitz, J. C. Van Zile and O. Winegard, all of Poughkeepsie. The plant includes a foundry, machine and pattern shop, and the new owners, who are all experienced foundrymen, are making many improvements. The plant will be known as the Dutchess foundry.

BRASS FOUNDRY NOTES

BY C. VICKERS

COLOR OF CASTINGS.

Question:—I am having trouble in getting color on my castings which I would like to have you give some advice. I am using

87. copper
3. tin
2. lead
8. spelter

100.

This metal colors up all right on light castings, but on chunky castings, it comes black out of the sand. I have got another mixture, but it is so expensive. It is as follows:

88. copper
6. tin
4. spelter
2. lead

100.

I must have the color.

Answer:—If the castings come out of the sand black, there is iron present in your metal. If you are using scrap copper wire you must look it carefully over, to see if there is any copper-plated iron wire amongst it.

This is on the supposition that you do not use any skimmings, turnings or brass scrap in your new mixtures, otherwise look after them first, for such materials afford an excellent opportunity for the introduction of iron into the brass.

If on investigation your copper is found free from iron, and you use no turnings and so forth, turn your attention to the spelter, as spelter often contains iron in sufficient quantity to discolor the castings. You can have the spelter analyzed, or obtain a small quantity of sheet zinc, which is sufficient pure for the purpose, and take off a trial heat, then you will have the satisfaction of knowing whether or not your spelter is at fault.

The presence of iron in brass can be easily detected. If the metal contains iron,—blisters will continually arise to its surface when in a molten condition. These blisters will appear black, and can be skimmed off as dross, when others will arise in their place and the skimming can be continued until the metal solidifies. Much of the iron can be removed in this manner, and if the brass is remelted, and the operation repeated the color of the alloy will be greatly restored. When blisters arise to the surface of brass as it is being skimmed, we may be certain that iron is present, and any castings poured from such metal will suffer accordingly in color. So if the color is an important point, to avoid direct loss, such metal will have to be diverted from its intended use, and run into ingots, or, into castings where color, or machining qualities are of no great consideration.

When the iron exists only in small quantity in the brass, it does no great harm, in small castings. They will appear with a fair color, but splotched here and there with dark patches, which will "tumble" off and leave the castings of the usual appearance.

This is the founder's end of it. The finisher, if he has much work to do on these castings, will not bless the founder for using such metal, for he will find the iron, in the shape of little nodules, scattered here and there throughout the castings. And these nodules are harder than steel, and will break his tools, causing much profanity and expense.

If no iron is found to be present in this alloy, the subscriber is mistaken in regard to the black color of his castings. The color is not black but green, caused by a strongly adhering greenish scale, which, when brushed off, leaves the casting whitish. This is due to the spelter in the alloy. The metal is too high in spelter to run chunky castings with a rich color. Any casting over ten pounds in weight will turn out greenish as aforesaid, unless it be large and thin, and there is no remedy short of altering the alloy and substituting bronze, such as the second alloy mentioned.

Having no idea what kind of castings these are, it is very difficult to suggest any alloy cheaper than No. 2, that would fill the requirements as to color. If the castings were bearings, the lead could be increased and the zinc decreased. The following alloy is suggested but the inquirer must be his own judge about using it.

Copper	88 pounds
Tin	4 pounds
Zinc	4 pounds
Lead	4 pounds.

YELLOW BRASS.

Question:—I am using punchings from sheet brass, rod ends and new brass of this character. I add from 3 to 6 per cent of spelter and 1 per cent of lead. Nevertheless my customers complain that my yellow brass castings turn very badly, the metal being too soft, they claim, taking too long to turn up, burning the turner's arms, etc. The turnings are more inclined to be curly than in dust form, as they desire. Now I fear to add more than 6 per cent of spelter, lest the light work will not bend nor dip well, but may crack. Could aluminum be safely used on the heavier work that is not dipped and how much? Can you

give me the information I need, what to add to the metal, etc.?

Answer:—Your brass is not sufficiently "leaded;" instead of one per cent, add three per cent of lead and the castings will machine much easier.

Lead makes copper alloys short and as much as six per cent may be added to the alloy you mention. I should advise, however, the use of but three per cent at first, and if on a trial the metal still proves unsatisfactory in its turning qualities, increase the lead to 3½ or 4 per cent. It should, however, be borne in mind that for dipping purposes lead is injurious as it causes black spots to show after dipping. A dipping brass should contain no other metals than copper and zinc, and these two may be used in all the proportions that form yellow brass, and dip well. Therefore, it is practically impossible to make a brass that will both dip and turn well.

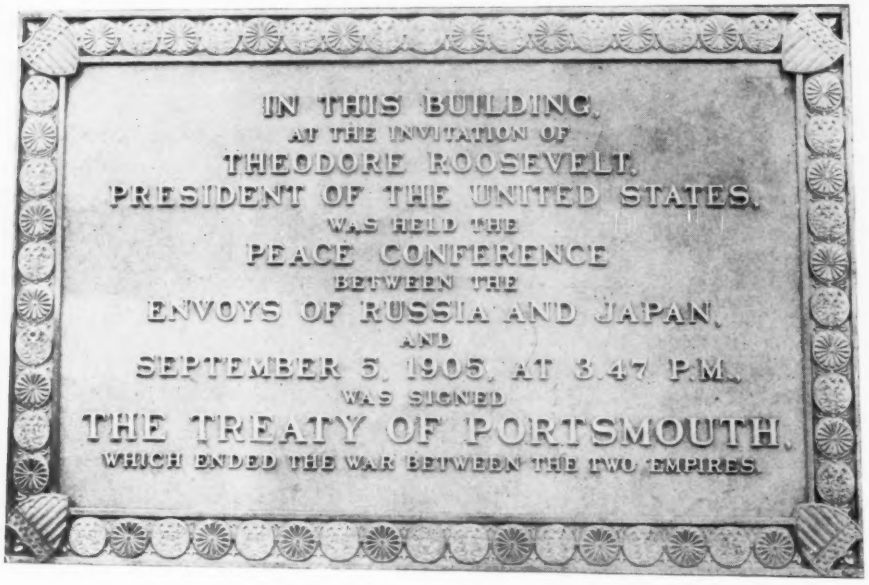
Lead is the friend of the brass-finisher, as it lightens his labor; for this purpose it is indispensable; no other metal will take its place.

Aluminum has an opposite effect to lead; it makes the metal harder to machine, and will cause other difficulties in casting that the user will be sorry he got acquainted with.

The addition of more spelter to the alloy will not cause it to machine any easier, although the mixture might stand more, if it were desirable to cheapen it.

The composition of the punchings, etc., is probably "three to one," that is, three parts copper to one of spelter. Ordinary yellow brass is a two to one mixture. Roughly speaking, we may say that 100 pounds of common yellow brass contains 66 pounds of copper to 33 pounds of zinc, and many high brass alloys carry still more zinc.

A three to one alloy will consist of 75 pounds of copper to 25 pounds of zinc; the addition of six pounds more zinc gives an alloy containing 75 pounds copper and 31 pounds zinc; the addition of three pounds of lead will make a good grade of yellow brass for turning.



CASTING A MEMORIAL TABLET.

CASTING OF A MEMORIAL TABLET.

In all ages the metallurgist has played an important part, both in war and peace. In the wars of the past the bronze foundry has supplied a large proportion of the cannon used, but at present the

steel foundry or steel works has taken its place and furnishes practically all of the artillery now used. Nevertheless, the casting industry is an important one, even in war time. It is, however, the founder who usually casts the statue commemorating the victory or the return of peace. In this connection it is interesting to note that a tablet has recently been completed by the firm of Jno. Williams, Inc., of New York City, to commemorate the signing of the peace treaty between Russia and Japan. This tablet has been placed on the walls of the now historic building, No. 86, in the Kittery navy yard at Portsmouth, N. H., where the treaty of peace was signed on September 5, 1905. The accompanying illustration shows this tablet, which is five feet six inches by three feet seven inches. It is cast from United States statuary bronze, the composition of which is 90 per cent copper, 7 per cent tin and 3 per cent zinc, the finest grade of Lake Superior copper being used.

After the alloy was melted and in the pot, certain additions were made on account of the historic nature of the tablet. These consisted of Japanese coins and copper from Japanese mines, Russian coins and American coins, among the latter being a few small silver coins. Bronze from various historic sources was also added.

The workmanship upon the tablet is of the highest and most artistic order throughout. The border consists of seals, which are alternately those of Russia and Japan, with the exception of the fact that in the center of the top and bottom rows the seal of the United States has been placed. The design was made under the direction of Rear Admiral W. W. Mead, U. S. N., Commander of the Portsmouth navy yard, by Pay Inspector John A. Mudd, U. S. N.

The Chicago Pneumatic Tool Co., Chicago, has issued a standard size catalog, 6 x 9, containing 116 pages, describing the various types of Franklin air compressors and showing the application of these compressors to various classes of work, such as pumping water by compressed air and other special uses, in addition to the regular standard work for which the compressors are usually made. The catalog also contains some very useful tables and matter concerning machines of this type, including the advantages of intercooling and compounding, and tables for laying out pipe lines and other similar purposes.

The E. H. Mumford Co., Philadelphia, has issued a standard size catalog describing the molding machines and other devices manufactured by this company. The catalog is unique in a good many respects. First, it is very neatly printed on buff tinted paper, and, second, in place of the ordinary preface there is a page with the heading "A Prologue to a Catalogue without Epilogue," and a brief statement which is as follows: "We present a few cuts, a few words and a few ideas with little attempt of enough orderly arrangement to make it a catalog. As you find here molding machines, so will you find them in the foundries, without, perhaps, much pride of ancestry, but affording great hope of posterity.

"You may not find here what fits your case; nor do we contend that you necessarily should, but such machines as are here portrayed we know how to apply, and that's half the wisdom in machine molding, as in porous plasters. The other half is in knowing what you need if it's not here, and we know that, too, and how to make it. So tell us your wants, and at the worst we'll not enhance them. At the best, the same sand that formerly fed scrap to your cupola will pan out gold, just as if it were up in the Klondike, and we save you the transportation there."

The machinery described in the catalog includes plain power ramming machines, power ramming split pattern machines, portable machines, hand ramming stripping plate machines, jolt ramming machines, and multiple molding machines of the Rathbone type. Combinations of several of the above types are also illustrated and described.

METALS IN FOUNDRY PRACTICE

Devoted to inquiries from Practical Foundrymen on subjects relating to the Melting and Using of Cast Iron, Malleable Iron and Steel.

The following experts answer questions in this department:

W. J. Keep, Cast Iron.

J. B. Nau, Metallurgy of Steel and Steel Castings.

Dr. Richard Moldenke, Malleable Castings.

We have also made arrangements with several others to act as special contributors. All inquiries should be addressed to the Editor of THE FOUNDRY, and they will then be forwarded to those in charge of the different subjects.

CAST IRON NOTES.

BY W. J. KEEP.

COMPOSITION OF CAST IRON.

Question:—(1) Does the determination of silicon from drillings taken from a casting indicate the quality of casting? (2) Is the silicon evenly diffused through all castings made at the same heat?

Answer:—(1) The varying of silicon is the practical way to vary quality. Increasing silicon softens. Strength, however, depends largely on low phosphorus and sulphur and on using pig irons and scrap that will produce a close uniform grain.

(2) Equal diffusion of silicon depends upon the methods of melting. In a large cupola with uniform charging or in any cupola where a large quantity of iron is accumulated, before tapping, or when a mixing ladle is used, yes; but in a small cupola drawing the iron as fast as melted, no; unless a mixing ladle is used.

Question:—How much variation from the calculated composition of a cupola mixture must be expected?

Answer:—I happen to have an interesting example that answers this question.

The coke used was solvay coke with sulphur below 0.8 per cent. Ten pigs from each car of iron to be used were selected at random, and drillings taken from several places in a clean fracture and gave the following composition:

Pig Iron.	Silicon.	Phosphorus.	Sulphur.	Manganese.	Lbs. chgd.
A	7.10	.959	.048	.55	220
B	2.73	.69	.021	.92	490
C	2.46	1.40	.029	.42	480
D	2.18	1.48	.025	.40	430
E	1.80	1.47	.046	.40	330

Thirty-five tons were melted in a cupola lined to 64 inches inside and the test bars were taken at the middle of the heat. Drillings from test bars one inch square gave a composition as shown below, and the calculated composition is also shown. Supposing that the 1,050 pounds remelt was of the same composition as test bar:

	Silicon.	Phos.	Sulphur.	Mang.
Analysis.....	3.09	1.22	.071	.51
Calculated....	2.95	1.21	.045	.517

It is supposed that 0.25 per cent of silicon is lost in remelting and that .10 manganese is lost. That .03 per cent of sulphur is gained and that phosphorus remains unchanged, silicon should have been 2.75 and Mn. .42. The only explanation is that the silicon of sample pigs did not represent the carload.

The next day in our 22-inch cupola we made a half-ton heat using the pigs from which the drillings for analysis had been made. The blacksmith cut the pieces so as to give exactly the same proportions of each iron to the 200-pound charge in the small cupola as there had been with the 3,000-pound charge in the large cupola. The composition was:

	Silicon.	Phos.	Sulphur.	Mang.
Calculated....	2.96	1.214	.046	.5327
Analysis.....	2.70	1.236	.074	.51
	.26 loss	.022 gain	.028 gain	.0227 loss

This is exactly as calculated except that manganese did not lose as much as expected and phosphorus gained a very little. The loss of silicon and the gain in sulphur was exactly as calculated, showing that with a correct representative sampling of the pig irons the composition of castings by analysis will correspond to that by calculation. The correspondence in every day melting is near enough.

The smaller the amount of iron melted the more chance of unequal diffusion of silicon in the castings. The above mixtures are stove plate iron castings less than ⅛-inch thick.

IRON FOR COFFEE GRINDERS.

Question:—Can you recommend a good brand of pig iron, fluid, but not searching, so as to give a smooth surface, while hard when broken, for coffee mill castings?

Answer:—A chilling iron must be used. Because an iron makes white castings it is not necessarily a chilling iron. Some white iron will not hold an edge, but can be dented with a hammer. I should advise the use of old car wheels or a white car wheel iron. You can add some gray pig iron—enough to make the iron fluid enough to run. White iron must be melted and poured very hot to fill the teeth of the casting and will cut the sand.

Use a plumbago facing and you might mix sea coal facing with your sand.

You will be obliged to get the surface by use of sand blast or with a tumbling barrel.

TRADE PUBLICATIONS.

The Wellman-Seaver-Morgan Co., of Cleveland, O., has issued two catalogs which are of standard size, 9 x 12 inches, both dealing with equipment for steel works. One is entitled "Section C" and illustrates and describes the line of open-hearth furnaces of various types manufactured by the Wellman-Seaver-Morgan Co. The catalog is remarkably well illustrated and will certainly be found of interest to those engaged in this line of work. In addition to open-hearth furnaces there are illustrations of continuous heating furnaces and soaking pits. The other catalog is entitled "Section D" and treats of charging apparatus for open-hearth furnaces. The various designs of furnaces and conditions in different plants have necessitated many variations in the designing of charging apparatus, and this catalog covers a very great variety for handling all classes of products. It also includes transfer tables for handling ingots, ingot strippers, soaking pit charging cranes, etc.

The B. F. Sturtevant Co., of Hyde Park, Mass., is sending out one of the most attractive catalogs which it has been our pleasure to see for a long time. The subject described is the Sturtevant high-pressure blower. The cover is of gray press board and has an illustration of a blower embossed on the front. The machine and its operation are very fully described and illustrated by many detail drawings and half-tone illustrations. The catalog also contains useful tables, reports of cupola tests, descriptions of various forms of motors and engines for driving blowers and other information which will be found useful to all engaged in the foundry business.

The Yale & Towne Mfg. Co., of Stamford, Conn., is sending out from its New York office a number of very attractive little catalogs advertising the Yale padlocks and showing the various uses to which they can be applied. We believe that there are a number of uses for these handy locks which can be found about the foundry, especially in connection with the supply department.

John A. Rathbone, 44 Buhl block, Detroit, Mich., is sending out a small catalog, 3½ by 6 inches, entitled "Multiple Molding." In this publication is illustrated and described the multiple molding machines of the Rathbone type. These machines have been introduced into a number of prominent plants and are said to be giving very good satisfaction for many classes of work, especially where a large production is required with a limited floor space.

The Joseph Dixon Crucible Co., Jersey City, N. J., has just issued a standard size catalog, 6 x 9 inches, containing 20 pages and entitled "Air Compresssor Lubrication." In this work the advantages of the use of flake graphite for air compressor lubrication are very clearly set forth, also the methods of use.

The Smooth-On Mfg. Co., Jersey City, N. J., is issuing a 4-page folder, the first page of which is devoted to a description of the Smooth-On corrugated steel gaskets used for joints in steam pipes. These gaskets are covered with Smooth-On elastic cement and then used like an ordinary gasket and it is claimed will give very much better results than any form of gasket thus far brought out. The last three pages of the folder contain letters from customers using the gaskets.

THE FOUNDRY

PUBLISHED MONTHLY BY

THE PENTON PUBLISHING CO.

CLEVELAND
BOSTON DULUTH CHICAGO
CINCINNATI NEW YORK
PHILADELPHIA
PITTSBURG

The subscription price of THE FOUNDRY is $1.00 a year to points in the United States, Canada and Mexico. To Great Britain: Eight Shillings. Single copies 15 cents each.

Change of advertising copy must reach this office on the 10th inst. preceding date of publication.

The Cleveland News Company will supply the trade with THE FOUNDRY through the regular channels of the American News Co.

European Agents: The International News Company, Breams Building, Chancery Lane, London, E. C., England.

Practical articles pertaining to the trade in all its branches are solicited and will be paid for.

When sending articles be sure to place your name and address on the article and on the drawings.

Entered as second-class matter at the Post-Office at Cleveland, Ohio.

PRINTED IN AN OPEN SHOP.

CONTENTS.

Beginning of American Malleable Iron... 303
Foundry Mixtures... 309
Thermit Repairs in Steel Castings... 316
Fluorspar as a Flux... 318
Early Foundry Practice... 319
Metallography Applied to Foundry Work... 320
Coke Sampling for Foundries... 324
Ferro Alloys... 325
New Books... 327
A Foundry Rig... 328
Relationship Between the Molder and the Patternmaker... 329
Development of a Screw Propeller from the Patternmaker's Standpoint... 332
Molding Cast Steel Truck Bolsters... 335
Plant of the American Brass Works... 342
Brass Foundry Notes... 344
Casting a Memorial Tablet... 346
Cast Iron Notes... 348
Trade Outlook... 350
Location of the Foundry... 351
Associations and Societies... 353
Among the Foundry Supply Fraternity... 362
Trade Notes... 368
Personals... 369
Deaths... 369
Fires... 370
New Construction... 370
General Industrial... 374

TRADE OUTLOOK.

As the first of the year approaches, the trade outlook for the foundry field is decidedly encouraging. The malleable and steel interests are all carrying several months of orders on their books. It is practically impossible to obtain malleable castings of any description short of 90 days delivery, and some will not quote short of six months delivery. The steel foundries are, in many cases, equally busy. In most sections both heavy and light gray iron jobbing foundries, as well as the foundries in connection with manufacturing concerns, are crowded with work. It is claimed, however, that some jobbing foundries have been closed temporarily on account of the fact that the price obtained for castings has not advanced sufficiently to warrant foundrymen paying the ruling high prices for pig iron, and hence these firms preferred to close their doors until either the price of pig iron fell or the price of castings advanced. It is certain that such cases as this are rare, but that they occur at all is an indication that our manufacturers must be careful not to pass the danger point which leads to a downward tendency in the markets and a general slump. It is to be hoped that, as the coming summer approaches and the railroads become able to handle the freight better, more steady conditions will return.

The very small amount of stock carried by some eastern foundries is illustrated by the fact that the delay in arrival of one 4,000-ton shipment of foreign pig iron resulted in the temporary closing of several works.

No. 2 foundry iron is held at $25.00 valley furnaces for prompt delivery, but it is doubtful if there is any real spot iron in the hands of any of the valley furnaces. Some small lots have been supplied under urgent demands from customers from time to time, but it is probable that such lots were diverted from that which should have gone to supply other contracts.

Second quarter iron is quoted at $23.50 to $24.00 valley furnaces for No. 2 foundry. It is reported that foreign No 3 Scotch iron has been sold in the Pitts-

burg district delivered for $24.60. It is also reported that two lots of No. 2 southern iron have been sold into the Pittsburg district on the basis of $19.00 Birmingham. This, however, is below the price asked by most of the southern furnace interests, as No. 2 southern iron is quoted at $22.00 Birmingham for either prompt delivery or first quarter delivery. For second quarter delivery, furnaces are asking $19.00 Birmingham.

The extensive car shortage in the south has resulted in the piling up of considerable iron in the southern furnace yards. The southern furnaces are also handicapped by the recent advances in freight rates, and by still further advances which are threatened for the future.

One of the most serious handicaps on the foundry trade has been the difficulty in obtaining coke, due mainly to the shortage of cars. Standard 72-hour foundry coke on yearly contracts is quoted at from $3.85 to $4.00 in the Connellsville district, while for shipments prior to July 1, it is quoted at $4.00 to $4.25 per ton.

ANNOUNCEMENT.

On January 1st H. M. Lane, who has been editor of THE FOUNDRY since October, 1903, will sever his connection with the Penton Publishing Co. to engage in the practice of consulting foundry engineering with headquarters in Cleveland. Mr. Lane also expects to have New York connections, and will be in a position to advise on all classes of foundry construction and foundry metallurgy, including gray iron, steel and malleable. He will continue his position as secretary of The Foundry Supply Association for the present, and devote a much larger amount of his time to the work of the association than would be possible under the former arrangement. This will redound to the success of the convention of The American Foundrymen's Association in Philadelphia, May 20 to 24 next.

Mr. A. O. Backert, formerly Pittsburg editor of *The Iron Trade Review*, and later western editor of *The Iron Age*, with headquarters in Chicago, will succeed Mr. Lane as editor of THE FOUNDRY. Mr. Backert has a wide acquaintance among foundrymen, and was prominent in the work of The Pittsburg Foundrymen's Association for several years.

LOCATION OF A FOUNDRY.

There has been a good deal of discussion during the last few years as to the best location for a foundry. Some of the factors which enter into the question are the original cost of the land, the labor market, the supply of raw materials, the market for the foundry product, shipping facilities, etc. These factors all have to be balanced one against another. A number of large manufacturing concerns have been showing a tendency to move their foundry departments out of the city into the suburbs or into small towns. In nearly every case the first difficulty met with has been the moving of the help from one place to another. In the case of a plant employing a great deal of skilled labor it is generally possible to move the works from one point to another and recruit the additional help required either by inducing the skilled workmen to move to the new location by holding out to them prospects of life in a suburban location, with plenty of fresh air, sunshine and a garden spot, or by attempting to break in and train the local help. This latter method generally results in robbing the agriculturist of his laborers. A great many experiments have been tried along this line and very few of them can be said to be entire successes.

In most cases it certainly pays to lay out a good, modern, sanitary townsite, and insist on sanitary regulations. Such work includes the laying out of a sewer system, water works, etc. The financing of this end of the project must be accomplished either by the manufacturing company or by some real estate company. From an economic standpoint it is best that the project at least be affiliated with a manufacturing project, and that the lots or houses in the new village be sold or rented at such rates that only a fair profit will be returned from the investment. A project of this kind can be more quickly killed by an attempt to make a big real

estate boom of the land end of the deal than in almost any other way, and we know of a number of commercial enterprises which have had to be abandoned that should have engraved on their tombstones, "Died a martyr to the real estate craze." Such catastrophies as this are unfortunate, as they usually drag the works down with them.

One question that is confronting the American people today is how to induce the American born workmen to remain in our factories. Workingmen of this class demand certain things. First of all they demand recreation and amusement, and any venture which attempts to isolate the workingman and prevent his having a good time must of necessity fail. The only thing in the world that a man works for is the privilege of spending his money. If he can be induced to spend this money on a home and home enjoyments so much the better, but the young man must have some wholesome amusements and some way or channel for spending his money. Most of the reformers along this line are fanatics who ride one hobby or another. One will try to construct a temperance town, and then induce the factories to come there. Another will try to construct a town the residents of which all belong to his particular faith or cult and then induce factories to locate there.

On the other side we have the man who is interested in the factory only and does not care who does his work so it is done well. This utilitarian individual is likely to try to herd his help into the poorest and cheapest kind of cattle pens that they will stay in. We believe that a good workman is always a self-respecting man, at least when he is sober, and that in his sober and industrious moments he is usually a good citizen. Acting upon this principle, any management which desires to locate a plant in the suburbs should see first that the help is properly housed, and, second, that there is a legitimate and proper means provided for them to spend their money. We do not believe that the responsibility of the employer ceases when the employe closes the factory door behind him on his way home. At the same time, however, it is very easy to err in the opposite direction and run to paternalism.

The arguments usually advanced in favor of maintaining a foundry in the city are that it is then in the handiest possible position to the labor market, the raw material and the handling facilities. A judicious selection of the site will usually afford us as advantageous handling facilities in a suburban location. The suburban location has the advantage of a much lower land value and hence lower taxation.

We know of one plant which outgrew its old location and figured upon purchasing more ground adjoining the plant. The price of the land, however, was found to be so high that it set the management thinking, and finally an entirely new plant was put up in the suburbs at approximately the expenditure that the additional block of land would have necessitated.

When the whole matter is summed up the principal trouble lies in the difficulty in moving men. Man is certainly a gregarious animal and it is difficult to break up the flock and make them take a new nesting place. The principal incentive which induces a man to go to a suburban location is, in the case of the higher class of help, the ability to obtain more light, sunshine and room. In the case of the lower class of help the suburban manufacturer must pay a slightly increased rate of wages, but it is a question whether this is not compensated for by the advantages to be derived from a situation where there is plenty of ground available, plenty of light and room for expansion.

A helper who must be told what to do every day, is more of a holdback than a helper.—*The Obermayer Bulletin.*

The Marion Steam Shovel Co., of Marion, O., has increased its capitalization from $500,000 to $1,000,000.

The Bucyrus Co., South Milwaukee, Wis., manufacturer of steam shovels, has added to its capacity by the purchase of the plant of the Manville Covering Co., adjoining its own works. The Manville plant, which is a four-story brick building, has not been in operation for some time.

ASSOCIATIONS AND SOCIETIES.

New England Foundrymen's Association.

Fred F. Stockwell, Secretary, care of the Barbour-Stockwell Co., Cambridgeport, Mass.

The regular monthly meeting of the New England Foundrymen's Association was held at the Exchange Club, Boston, Wednesday, Dec. 12, with President Walter B. Snow in the chair. The Vanderman Plumbing & Heating Co., Willimatic, Conn., was unanimously elected to membership.

Announcement was made that the next meeting would be the annual meeting of the association, and it is proposed to have many special features for entertainment. The chair appointed as a committee on arrangements, Messrs. Fernald, Arnold, Breen, White and Lovejoy. An invitation was extended to the members of the Philadelphia and Pittsburg Foundrymen's Associations to be present at the annual meeting.

A very interesting paper was then read on "Evils and Restrictions of Carelessness," by Thos. D. West, of Sharpsville, Pa.

This paper was presented in view of the prevalence of carelessness in many manufacturing plants today, and because of the general tendency toward laying upon the employer the responsibility for all accidents that occur in his plant. It was Mr. West's intention to gather a large amount of data from notes and clippings concerning the matter of accidents, but the instances became so numerous as to make any resume of the continually occurring mishaps out of the question. Anyone who desires an idea of the actual extent to which carelessness is productive of accidental damage to life and property, need only attempt to make such a collection of clippings as Mr. West had thought to undertake for, though most accidents perhaps occur in connection with avenues of transportation, both in their construction and operation, manufacturing establishments, especially foundries, are the scene of a distressingly large number of injuries and fatalities.

The speaker went on to say that while the first thought of the public in case of an accident was to blame the employer and point out that so long as another laborer could be obtained to fill the place of the one injured, the matter was of no concern to the company, at the same time, it is to be remembered that in a large majority of instances, accidents of anything like a serious nature involve either actual damage to the plant much in excess of the damage received by the one injured, or have an influence upon the other employes of the plant to such a degree that a great loss results in work done. There is but a poor conception among those not directly interested of how great the precautions are and how expensive to the employer, for avoiding the possibility of accidents, because long experience has shown to the operators of plants that the greatest weight of an accident falls upon them and not upon the workmen. Mr. West decried the practice of a certain class of lawyers who seek to take advantage of the ignorance of workmen whose interests they pretend to serve, but, whom, at the same time, they use only as victims by seeking to make even the slightest accident the basis of proceedings for judgment.

In addition to those accidents which involve personal injury, the speaker included those accidents and mistakes which are the direct result of carelessness in handling material and performing such operations as are involved in various manual occupations. In the running of a large shop or foundry, it was the intent of the paper to show that the employe is constantly guilty of making errors for which the employer must pay and for which he has no redress beyond the discharge of the employe, the entire list of mistakes being the direct result of carelessness or thoughtlessness on the part of the employe. Mr. West made a plea for some legislative or educational provision whereby the employe could be so restricted as to cause greater carefulness in his work or could be disciplined so as to acquire habits of greater accuracy and care.

In his closing remarks, Mr. West intimated that a condition of civilization was desirable where carelessness would

be considered criminal instead of the present existing condition where it is more often winked at.

After dinner was served, Herbert E. Field, of Pittsburg, Pa., delivered an address on "Foundry Education."

Philadelphia Foundrymen's Association.

Howard Evans, Secretary, care J. W. Paxson Co.

Plans for entertaining the annual convention of the American Foundrymen's Association, which is to be held in Philadelphia next May, were discussed at the monthly meeting of the Foundrymen's Association of that city, which was held at the Manufacturers' Club Dec. 5. Dr. Richard Moldenke, secretary of the Am. Foundrymen's Asso. and H. M. Lane, secretary of the Foundry Supply Association, were present and spoke of the great interest felt in next year's convention. A movement is under way, Dr. Moldenke said, to form an association of brass foundrymen, and it is expected to have 200 to 300 of them in attendance, while he estimated the number of foundrymen likely to be present as fully 1,000. Mr. Lane, speaking for the Supply Association, said that the work was progressing; very satisfactory replies had been received from dealers in answer to letters sent out, and applications for space were already coming in. The Second Regiment Armory had been leased and some outside ground secured. The interest shown was greater than ever before and he predicted a large attendance. In answer to questions he said that the rates for space for exhibition purposes had been fixed as follows: 100 square feet, $15; 200 feet, $25; 300 feet, $35; 400 feet, $40.

In a discussion as to finances, in which Stanley Flagg Jr., President Devlin and others joined, it was estimated that from $3,000 to $4,000 would be required for the proper entertainment of the guests, and it was decided that vigorous efforts should be made to raise as much money as possible after the first of the year.

The present officers of the association were unanimously recommended as follows, (to be elected at the January meeting): President, Thomas Devlin; vice president, Alex. E. Outerbridge Jr.; treasurer, Josiah Thompson; secretary, Howard Evans; executive committee, H. O. Evans, Thomas M. Eynon, E. E. Brown, R. C. Oliphant, George C. Davis; trustees, Thomas Devlin, Josiah Thomson, Howard Evans; official chemist, George C. Davis. Albert M. Moyer, representing R. T. Randall & Co., of New York, was elected to membership.

E. H. Mumford, of the E. H. Mumford Co., gave an interesting talk on "The Rathbone Multiple Molding Machine," illustrated by lantern slides, and J. W. Daniels read a paper on "Sheet Steel Adjustable Flask Jacket," an invention for which H. C. Caldwell, of Philadelphia, has made application for a patent.

Pittsburg Foundrymen's Association.

F. H. Zimmers, Secretary, care Union Foundry and Machine Co., West Carson Street.

The regular meeting of the Pittsburg Foundrymen's Association was held on December 3. Practically the entire evening was taken up by the presentation of a paper by Dr. Noyes, of the Bureau of Standards, Washington, D. C. Dr. Noyes set forth the object of the bureau and described the fundamental measures or standards in possession of the government. He also spoke of the work of the Chemical Division, which is the division which took over the standard borings which had previously been furnished by the American Foundrymen's Association.

British Foundrymen's Association.

F. W. Finch, Kingston House, Lonsdown Rd., Gloucester, Eng., Secretary.

A meeting of the Birmingham branch of the British Foundrymen's Association was held at the Municipal Technical School, Birmingham, England, on Saturday, Nov. 17, Mr. R. Buchanan, president, presiding. There was a good attendance, the attraction being an address by Professor Turner, of the Birmingham metallurgical department, on "Shrinkage and Volume Alteration During Cooling."

Professor Turner on "Shrinkage."

The chairman introducing the lecturer, said Professor Turner was known all over the world as a most distinguished metallurgist, especially in regard to cast

iron. His own connection with Professor Turner was somewhat ancient, going back eighteen years, to a period shortly before the professor announced the great fact of the true influence of silicon on cast iron. There was undoubtedly then in the minds, not only of scientists, but also of manufacturers an idea that the professor was wrong. He remembered a book published about that time by Mr. Greenwood, who stated that silicon had an influence altogether different from what the professor had proved it possessed. The period of scepticism had passed away because the fact was established. No doubt the professor's name would always be associated with that most important discovery. That discovery had the still larger effect of awakening in the minds of scientists, as well as of practical men, a sense of the enormous importance of the study of cast iron, and interested people were devoting more and more attention to understanding its nature and possibilities. The professor had opened up a new era for investigation which was not at all near its close. Many devoted workers were investigating the constitution of cast iron, and the various effects that the different elements had on the material as well as on one another. There was no fear that the subject would be exhausted within the next few years. They had heard that Professor Howe, of America, had made something like 3,000 experiments with carbon on cast iron endeavoring to find some deeper law that would run through the different effects, and dealing with varying percentages of carbon, and their action on pure iron. At the end of his experimenting he practically said he did not know anything about the subject. Personally, he thought that a somewhat modest way of stating the position. Yet the writer had indicated that view in regard to what one would think was the simpler problem of the effect of simple carbon on iron, which was a subject which they would have thought could be grasped, and regarding which some finality could be reached. But when they came to consider cast iron there were so many other elements, sulphur, phosphorus, manganese, and others, in addition to carbon, disturbing the general conditions that one could see that the problem was much greater than that of simple carbon alone.

Professor Turner acknowledged the sympathetic reception of the chairman, to whom he was very much indebted for the practical work he did when the subject was less known and the results not so well recognized as now. Mr. Buchanan was one of the earliest to show by the tests he had made and which were forwarded to him for examination that what they had determined as to the influence of silicon really was correct. He had always received the greatest possible assistance from practical men, and the men who had disputed the correctness of his conclusions had been the theoretical men, the teachers, and the book writers. Recently they had a research published dealing with silicon and cast iron in Vol. 2 of the *Journal* of the Institute, in which the whole question was raised. It was now suggested that white iron gave the best results. His own criticism was that obviously that must be wrong, because the result obtained did not agree with the practical experience of the last twenty years. When they asked why the results were wrong they were acknowledged to be irregular by the author. The answer was (1) that the test was altogether wrong, and (2) because of the way the curves were arranged in that paper. The author had taken percentages on one side, and numbers on the other. He had endeavored to show that one and one are two, and for that purpose he took one horse and one cart, and added them together.

Proceeding with his address the professor regretted that want of time had prevented him writing a special paper, but he called attention to the paper read at the Iron and Steel Institute, contained in the *Journal* of the Institute, No. 1, for 1906. The following facts were matters of common knowledge in the foundry:

1. That a casting is smaller than the pattern or the mold. There is always

a certain amount of diminution in size, or contraction.

2. That the difference in size varies with the shape of the casting, and the mixture that is used. Sometimes the caster will allow half as much more for shrinkage than on other occasions.

3. That thin castings contract more than thick ones, and therefore the founder has to make a different allowance per foot.

4. That gray iron or soft iron contracts less than hard or white iron. When the founder is casting something hard he knows he must make the pattern larger, so as to allow more for shrinkage.

5. That solid cast iron will float on fluid cast iron. It behaves very much like ice floating in water.

6. During solidification in a mold, especially with large castings the fluid metal in the gate rises and falls. They sometimes supposed those changes were due to air bubbles.

7. That graphite in the form of "kish" separates from molten gray iron in the ladle.

8. That rapid cooling hardens cast iron.

9. That on prolonged heating white iron becomes annealed.

10. That gray iron is permanently expanded by repeated heating. It was possible to increase the bulk as much as forty per cent, merely by repeated heating, starting with a fairly gray iron. The iron becomes weaker and more porous, and those changes take place below the temperature at which iron melts.

All those facts, the professor continued, were different branches of the same subject and the true explanation had not been known until quite recently. In some respects, almost within the last few months, they had been able to give satisfactory, coherent explanations for those well known facts. The professor proceeded to give explanations of the various means for measuring the contraction of iron. The simplest form being the apparatus produced by Mr. W. J. Keep, of Detroit, U. S. A. The method of using this was shown by models, and lime light views. One of its merits, the speaker explained, was that it did not require expensive apparatus or special knowledge or training. It was simple, cheap and easy to apply. Dealing next with the question how the change in size was effected by composition the professor said that, speaking generally the more silicon they had in the iron the less was the contraction, while the harder the iron the greater the contraction. Any element which made iron hard increased the contraction, while anything which softened it, like aluminum, diminished contraction. He had found various varieties but he had never found the thick bar contract more than the thin. Some of the matters, such as the effect of the temperature at which metal was poured and the question of pressure, had not been determined. But there was no doubt a little extra wetness of the mold which caused a little more rapid cooling of the metal would cause rather more contraction, and it was very important also to keep quite uniform conditions, adhering to whatever size was adopted.

The professor next dealt with the question as to the precise occurrences during cooling, and as to the question of expansion during solidification. A number of views were thrown on the screen showing the precise expansion or arrests during cooling, giving special attention to the tests and observations made four years ago, and which answered various queries raised by Osmond. The expansiometer had proved of very great value in giving exact results. A number of further views showed precise results in the number of arrests in white, gray and phosphoric iron. So far, they had not met with a substance yielding more than three arrests, but it might be possible to produce a material having half a dozen expansions. Generally speaking, the more silicon they produced the more gray the iron became, and the greater the reaction. If they had white iron high in phosphorus they would expect to find two arrests. They had now pretty definitely proved the meaning of those expansions, and in what temperature they occurred.

If they went up to 0.9 of carbon they would get one pronounced arrest. There had been much discussion with regard to graphite and martensite. Recent experiments had proved that once separated during cooling, graphite did not again dissolve. They were now able to answer some of the questions. First, that carbon iron does expand during cooling and that it expands according to the known composition at certain definite times, and at certain definite temperatures, and if they had a diagram showing the cooling curves of a sample of pig iron, providing they knew approximately the chemical composition, they ought to know the mechanical purpose for which it could be applied. If they knew the amount of phosphorus in a sample, they ought to know whether it was a strong or weak iron. And those tests could be easily carried out in connection with any tests. Of course, the more information the foundrymen could give the better everybody would be pleased.

A discussion followed the lecture.

Mr. F. J. Cook thought the principle value of the lecture was that it led them to another mechanical test as a help to foundrymen, who were not good, as a rule, at chemical analysis; a mechanical test at which would give good information would be very valuable. He had himself used Keep's shrinkage test for three or four years, and he could recommend it as very useful, though they had to be careful they did not get large and small bars. If they had a man a bit careless they would get one bar bigger than the other. But if the test was applied properly, they could get the result in ten minutes. For castings of a certain class it was the best test but it was better to measure the bars on the ramming-up plate. The test was supposed to show the percentage of silicon, but there were other elements that affected shrinkage. At the same time silicon was the material factor, and if they put more in according to their requirements it would give the desired effect. Without any particular chemical analysis they could tell which was the softer iron, and could regulate shrinkage accordingly. He had had instances where big plates had been cast for a year or two, and had suddenly started buckling. By applying the test they had ascertained the reason, at once altered the mixture and stopped the buckling. He would like to know whether when the larger expansion took place it affected the molecules, and so caused sponginess, or openness. It might cause leakage, which sometimes did occur.

Mr. Thomas said that, as a member of the Metallurgical Society, he congratulated the foundrymen on having heard such an instructive paper. There was obviously a good deal of scientific knowledge which could be practically applied in the foundry with distinct advantage. He was not a practical foundryman, but speaking as a metallurgist it was pretty evident that an increase of silicon gave a greater volume of expansion, and that was practically the explanation why when a casting containing a reasonable percentage of silicon solidified they got less contraction. He should like to know if there was a point to which silicon in cast iron could be increased until an obverse effect was obtained, somewhat on the lines parallel with softness and hardness. He gathered from Professor Turner that the expansion in cooling was due to eutectics, and not to chemical changes. Where the metal was not an alloy they got a regular curve without any arrest. The allatropic theory seemed to have proved that the arrest might take place with absolutely pure iron, and it was due to the allatropic modification in the iron which took place during the process of cooling rather than to the eutectic. With regard to phosphorus he thought they had almost come to believe phosphorus had practically no effect on the carbon of the iron; but from the observations of the lecture it seemed evident that phosphorus had considerable effect either in the way of combining carbon or separating it out.

A member wished to know with regard to the saturation of pig iron with graphite which produced "kish," whether that was the cause of the spongy places in castings; whether the graphite sep-

arated out at a higher temperature than other elements and so produced the cavities in large casting which he had noticed generally occurred near the gate.

Mr. Mason remarked that as molders they had not the chance of making the experiments they would like. His own impression was that Keep's method was too complicated, whereas Professor Turner's method was simple, and anybody could do it. It was interesting to know that as a casting cooled it seemed to grow bigger.

Professor Turner: "It does not grow bigger in the yoke."

Mr. Mason: "But Keep's experiment shows that those two pins did expand."

Professor Turner: "When Keep did that experiment he did not have a yoke round."

The chairman pointed out that when the big expansion took place the iron was down to 700 degrees or in a fair condition of solidity, and hardly a bright red.

Mr. Mason said that description of what was happening after the casting would go a long way towards helping them in their difficulties in the foundry. Every week they had some trouble with castings, especially in the development of shrinkage holes. The cause was such a poser, and they found that next day the iron might come all right.

A member said his troubles had generally come when pig iron was saturated with "kish." He would like to know whether when pig iron containing "kish" was put into the furnace it came down in a dusty condition, while other iron would come down more fluid at the same temperature. He had known a kind of cream to come on top of the ladle, and he could only conclude that graphitic iron required a much higher temperature than the ordinary range of pig.

Mr. Cook said that in casting cylinders he had found most trouble with iron over-saturated with carbon, and the blow holes had sometimes occurred when iron had been taken from a stack which had yielded sound castings. He had found by analysis that the trouble arose with the purest iron, and especially when they had been using a good deal of scrap. The greater percentage of pure iron they had, the more liable they were to shrinkage. He had overcome the difficulty by leaving out a little scrap and putting in a little raw pig iron, and the shrinkage holes had disappeared straight away. The richer the iron the more likely they were to get cavities. The iron he was referring to did not contain more than three per cent of combined carbon. Silicon was about 1¼, phosphorus about 0.8, and manganese about 0.4.

Mr. Mason said his experience was quite different, because if they were short of scrap that was the time they got most trouble. They found that by increasing the scrap, and stopping the manganese they got rid of their trouble with shrinkage holes.

The chairman observed that shrinkage was like King Charles' head, it found its way into every discussion. It was one of those things on which foundrymen were profoundly ignorant. So far as he knew there was no single explanation of the shrinkage holes. He had a remarkable experience in which the same iron came sound out of one cupola and with holes out of another. He put it down in some degree to the larger quantity of sulphur which was taken up by the molten iron out of the coke, which was deeper in one cupola than in the other, and in the larger cupola they had a stronger blast than in the small one. He would like to know whether the growth of the casting was due to the rearrangement of crystals or the growth of graphite. He had never seen iron expand sufficiently to fill the mold, but possibly No. 1 iron expanded more than others. It was also interesting to know that hematite had two expansions against three in ordinary gray iron. He would like to know whether that third expansion was due to the expellent effect of silicon on the carbon.

Professor Turner, replying briefly on the discussion, said that where they had a third expansion very pronounced, they would get what was ordinarily called spongy iron, and consequently an un-

sound casting. As to whether high silicon led to greater contractions they had not carried the experiment sufficiently far with rich alloys, and, therefore, he could not say, but he would rather be inclined to anticipate that it would. As to the effect of phosphorus on carbon, the reason they said phosphorus had no effect on the carbon within range was that they generally got phosphorus in the proportion of one and one-half to two per cent in ordinary foundry iron. The writers who had contributed the paper had been dealing with 4.6 and 8 per cent. With high phosphorus they found that low carbon tended to be combined, but that was only in abnormal quantities, not in ordinary quantities. As to the formation of spongy places there was no doubt that "kish" did produce those soft spongy places, and dirt might also have that effect. On the other hand, they had those holes in very hard iron. The holes might be produced by too much or too little scrap. For instance, it seemed to him that Mr. Mason and Mr. Cook might exchange pigs occasionally. As to the cause of the growth of the casting, he had not any great theory. It looked to him something like the growth of lead on a roof, due to repeated exposure to sunshine. Repeated heating caused expansion until eventually the iron became quite spongy. It did not seem to be anything more remarkable than the raising of bread from dough; if they blew it up they made it big, and the iron was practically blown up, and made porous. He had no doubt that silicon had an expellent effect on carbon, breaking up what would otherwise be carbide.

On the proposition of the chairman, a hearty vote of thanks was accorded the professor, who suggested that in future they should hold a meeting at the university, which would enable them to inspect the metallurgical department.

Cleveland Foundry Foremen.

H. M. Lane, Schofield Bldg., Secretary.

The regular monthly meeting of the Cleveland club of Associated Foundry Foremen was held in the parlors of the American house on Saturday evening, Dec. 15. There was an unusually large attendance and a very successful meeting. After the transaction of the regular business and the reports of committees and officers, H. M. Lane gave a talk on the composition of cast iron, illustrating it with samples of the constituent elements, that is, silicon, over 99 per cent pure, manganese 99 per cent pure, phosphorus, sulphur, etc.

There were also illustrated castings from which practically all of the iron had been dissolved by subjecting them to several months' pickling in dilute acid. After the talk there was considerable discussion on the composition of cast iron and other subjects relating to foundry practice. The meeting adjourned at 10:30.

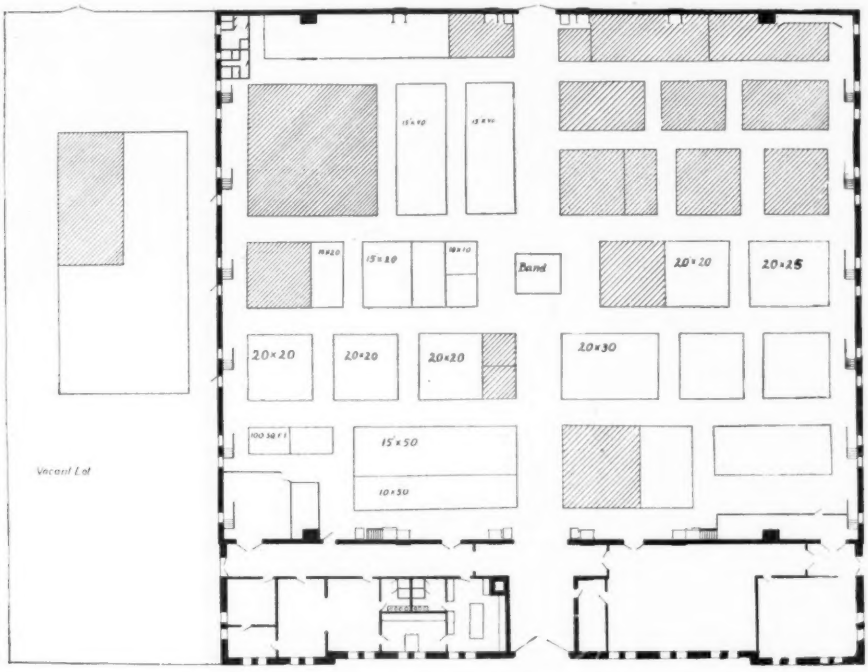
Foundry Supply Association.

H. M. Lane, Schofield Bldg., Cleveland, Ohio, Secretary.

The preparations for the convention of the American Foundrymen's Association to be held in Philadelphia May 20th to 24th next, are progressing very well, and the exhibit of foundry supplies and equipment to be held in connection therewith by the Foundry Supply Association, is now an assured success. A floor plan of the armory has been prepared, as shown in the accompanying illustration. The armory is a building 165 x 190 feet on the inside with a number of rooms adjacent, one of which will be used for the meetings of the A. F. A. Adjoining the armory at the side there is a vacant lot 100 x 200 feet in which there will be erected a temporary building for such exhibits as could not ordinarily be placed in the armory.

The space already definitely alloted is indicated by the cross-sectioned areas. In addition to that already allotted there are several applications which have been received which have not as yet been allotted on account of the fact that the size of the space has not been determined. It is expected that there will be a number of exhibits in the temporary

building in the vacant lot adjoining the armory. This will include oil melting furnaces and machines which require special foundations. Arrangements have been made for supplying compressed air for those requiring it. The exhibits already arranged for cover practically the entire line of equipment for foundries, but it is hoped that those who have not as yet joined the association or availed themselves of the opportunities in connection with the exhibit, will



PLAN OF THE SECOND REGIMENT ARMORY, WHERE THE EXHIBIT IS TO BE HELD.

make haste to do so while there is still space available.

This convention will undoubtedly be by far the largest gathering of foundry men which has ever been brought together, as it now appears certain that there will be over a thousand present from outside of Philadelphia. The program, as thus far outlined, is better than that presented at any of the previous conventions. The fact that the Brass Foundrymen's Supply Association will be organized during the convention assures the attendance of a very large number of foundrymen interested in brass foundry practice, and one session will be devoted to the brass foundry interests. The foundry foremen will, of course, as usual, be represented and hold special sessions.

H. M. Lane, the secretary of the Foundry Supply Association, has resigned his position as editor of THE FOUNDRY with the intention of devoting his energies to consulting foundry engineering, but the new arrangement will give him ample time to look after all of the necessary preparations for the Philadelphia convention and to make it the greatest success possible.

Applications for membership in the association, or for space in the exhibit, should be sent to H. M. Lane, Sec., Schofield building, Cleveland, O.

Cleveland Club of Associated Patternmaker Foremen.

H. J. McCaslin, care Wellman-Seaver-Morgan Co., Secretary.

The third meeting of the fall and winter series of the club was held Monday

evening, Nov. 26, and proved to be very interesting, though only a comparatively small attendance was present, as the evening was very stormy. Mr. Hibbs presented an exceedingly interesting paper on the patterns necessary for and the methods of molding standard cast iron water pipe. This was followed by considerable discussion on the subject, in which practically all joined. The meeting, as have several previous ones, partook of the nature of a smoker and was thoroughly enjoyed by all. On account of the holiday season it was decided not to hold another meeting until Monday, January 7.

AMERICAN FOUNDRYMEN'S ASSOCIATION.

Dr. Richard Moldenke, Secretary, Watchung, N. J.

PACIFIC COAST FOUNDRYMEN'S ASSOCIATION.

J. D. Morris, Secretary and Treasurer, Seattle, Washington.

BUFFALO FOUNDRYMEN'S ASSOCIATION.

John E. Gorss, Secretary, 23 Builders' Exchange.

THE ASSOCIATED FOUNDRY FOREMEN

Frank C. Everitt, care the J. L. Mott Iron Works, Trenton, N. J., Secretary.

NEW YORK FOUNDRY FOREMEN'S ASSOCIATION.

Hugh McPhee, The Hapcroft Gas Producer Co., Bridgeport, Conn.

PHILADELPHIA FOUNDRY FOREMEN.

W. P. Cunningham, Secretary, care American Bridge Co., Pencoyd, Pa.

MILWAUKEE FOUNDRY FOREMEN.

Julius M. Germanson, 931 Allis Street, Secretary.

CINCINNATI FOUNDRY FOREMEN.

E. W. Cadwell, Secretary, care S. C. Tatum Co.

CHICAGO FOUNDRY FOREMEN.

Mr. Thompson, Link Belt Co., District Vice Pres.

NEW YORK FOUNDRY FOREMEN'S ASSOCIATION.

C. H. Thomps, 14 Elizabeth St., So Norwalk, Conn., District Vice President.

ERIE FOUNDRY FOREMEN.

W. F. Grunau, Dist. Vice Pres., care Erie City Iron Works.

INDIANAPOLIS FOUNDRY FOREMEN.

W. S. Keller, of Hetherington & Berner Co., District Vice President.

HAMILTON, ONT., FOUNDRY FOREMEN'S ASSOCIATION.

A. Chase, care Sawyer & Massey Co., Secretary and Treasurer.

GENERAL INDUSTRIAL NOTES.

The Daniel McKenzie has leased the Udall foundry at Garrettsville, O., and will continue its operation.

The Ferro Foundry & Machine Co., Cleveland, making a specialty of cylinders for automobiles and marine engines, has taken over the business of the Detroit Auto Marine Co., which has been removed to Cleveland.

The Victor Foundry & Mfg. Co., Hamilton, O., has completed its new plant, which will have a capacity of 15 to 20 tons per day of light and medium gray iron castings.

The Cleveland Castings & Pattern Co., Cleveland, recently incorporated, succeeds to the business of the Gobeille Pattern Co. Its officers are: F. W. Wood, president; A. K. Spencer, vice president; D. G. Miller, secretary and treasurer; V. G. Farner, superintendent.

The Central Foundry Co., Hamilton, O., has been incorporated with a capitalization of $25,000 by John T. Gardner, W. L. Huber, C. E. Margedant, A. W. Margedant and W. C. Margedant.

George Wendling, C. O. Henderson, of Massillon, S. M. Brenneman, of Orrville, and others have organized a company to operate a foundry at Orrville, O. The capital stock is $5,000, and the company expects to have its plant in operation very soon.

The Brown-Ketcham Iron Works, Indianapolis, manufacturing structural and ornamental iron and steel, has opened a branch office at 918 Park building, Pittsburg, with John R. Keers in charge.

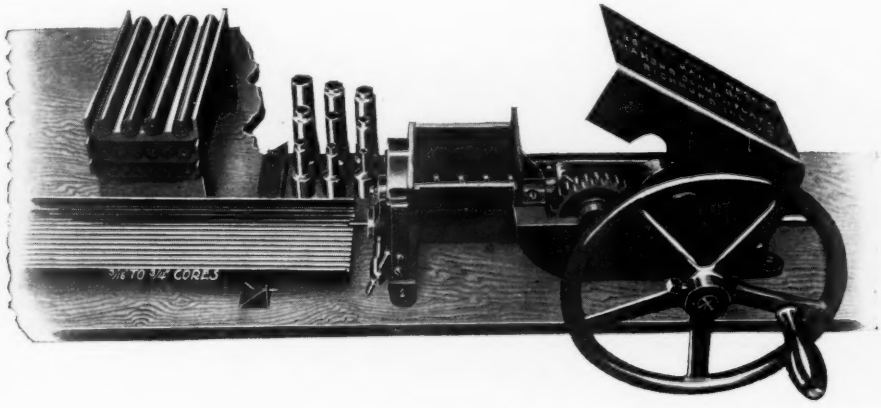
The firm of D. C. Stover & Co., Freeport, Ill., has been incorporated with a capital stock of $50,000. The incorporators are: D. C. Stover, J. P. Stover and Fred R. E. Dawson. A plant, including a foundry, is already nearly completed, and will be used for the manufacture of marine engines.

It is reported that Robert E. Barr, of Brown City, Mich., has purchased the Menery foundry, of Yale, Mich., and will conduct the business in future.

Among the Foundry Supply Fraternity.

THE DIAMOND CORE MACHINE.

Hardware manufacturers and others requiring small cores have long been searching for a machine that would make cores less than ⅜ inch in diameter. The ordinary screw feed core machine will not produce cores of this size economically, and hence Mr. Gartside, of the Diamond Clamp & Flask Co., Richmond, Ind., has developed a new machine which is shown in the accompanying illustration. This is for making cores from 3-16 of an inch in diameter up, with ordinary oil sand mixtures. By using a mixture of charcoal and plumbago mixed with oil, Mr. Gartside claims that cores as small as 1-16 inch in diameter can be made upon the machine and that the charcoal cores will give a smooth hole and a snug fit, such as is required in hinges. Also, in the case of holes which have to be tapped a charcoal core will leave no grit in the hole. The machine is provided with a screw which feeds the sand, and a device which packs it in the mold, and also a plunger which ejects the core or forces it out on to the plate. The standard also comprises a set of round core boxes ranging from 3-16 inch to ¾ inch, advancing by 1-16 inch, making ten sizes in all. Special dies or equipment can be furnished for other sizes.



THE DIAMOND CORE MACHINE.

A NEW RECORDING PYROMETER.

In this era of rapid technical progress in all industrial and manufacturing establishments where high temperatures are employed, there is an increasing demand for instruments to automatically and accurately record every change that occurs. Records obtained from such apparatus make it possible to control the temperatures, so that the product is perfectly uniform and most economically produced. The accompanying illustrations show a recording pyrometer of the thermo-electric type, which is capable of application to almost every commercial and industrial requirement. It has been devised by William H. Bristol, 45 Vesey street, New York.

The complete instrument consists of three distinct parts, namely: The recorder, which is located at the point

most convenient for observation of the records and for changing of the charts; the thermo-electric couple, the

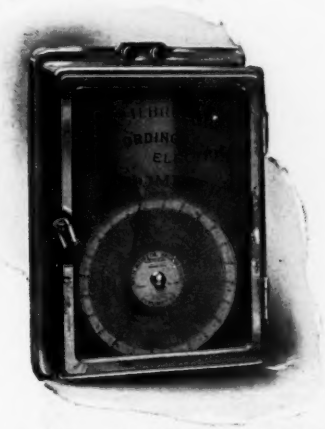


FIG. 1.—WM. H. BRISTOL RECORDING PYROMETER.

fire-end of which is to be inserted into the space where the temperature is to be measured; the leads consisting of duplex flexible cable for making the electric connection between the recorder and the fire-ends. An exterior view of the instrument is shown in Fig. 1.

The thermo-electric couple, which is located where the temperature is to be measured produces a current of electricity, which is communicated to the recorder through the connecting leads. This current actuates a galvanometer movement, which is contained in a dust proof metal case, shown in the upper portion of Fig. 2. The galvanometer movement is made according to a special design by the Weston Electric Instrument Co. with pivot and jewel bearings for the moving coil. It is "dead beat" in its action.

The recorder arm moves free and clear just in front of a chart, which is revolved by a clock movement once in every 24 hours, or at any other desired rate. These charts are prepared with a semi-transparent smoked surface, which is so sensitive that a record may be made upon it with a hair. When applied to the instrument, as shown in Fig. 2, the chart is supported only over a portion of its surface by a semi-circular plate, shown in the lower portion of Fig. 3. The clock movement for revolving the chart is contained in the round case behind

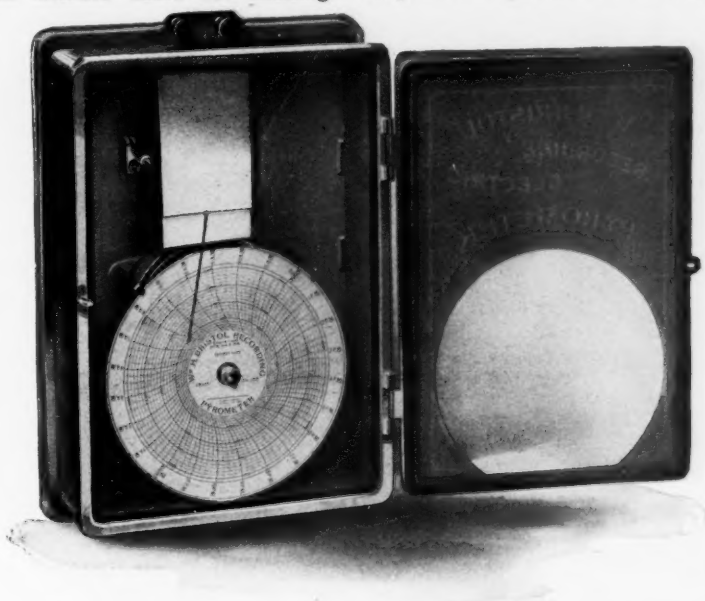


FIG. 2.—INTERIOR OF WM. H. BRISTOL RECORDING PYROMETER.

the semi-circular chart support, and is provided with an auxiliary attachment for periodically vibrating the unsupported portion of the chart, thus bringing the smoked surface into contact with the pointed end of the recorder arm at intervals of a few seconds. By this means, the record of its position is obtained and friction is eliminated.

The series of marks made by this periodic contact of the recorder arm, which removes the carbon from the chart, forms a continuous curve, unless the changes in temperatures are extremely rapid. After the record of the day is completed the chart may be removed from the instrument and "fixed" by immersion in a fixitive solution, which consists of gasoline or alcohol, to which has been added a small amount of concentrated fixitive. After fixing, the charts may be handled and filed without any danger of destroying the record.

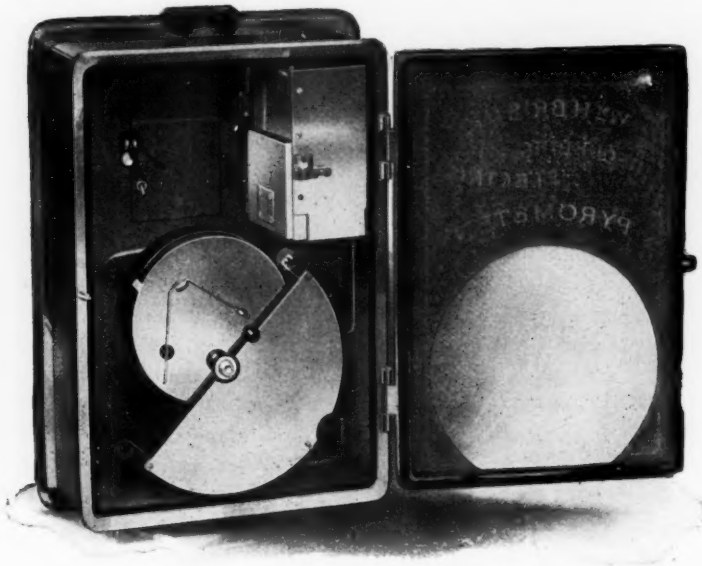


FIG. 3.—OPERATING MECHANISM OF WM. H. BRISTOL RECORDING PYROMETER.

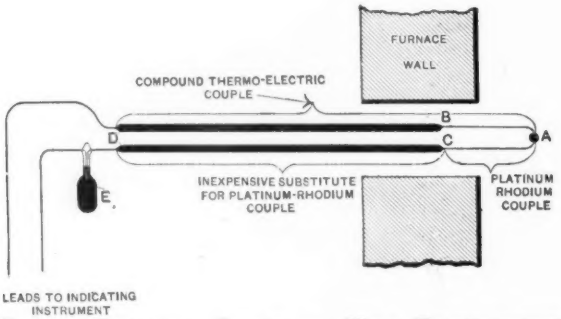


FIG. 5.—COMPOUND COUPLE FOR HIGH TEMPERATURES.

Fig. 4 is a reduced photographic reproduction of a smoked chart, with a record of the temperature in the lead bath, which is used for calibrating these pyrometers. It is interesting to

note the constancy of the temperature during the period of nearly half an hour, while at night the metal was cooling and passing from the molten to the solid state. The simplicity of construction insures durability and permanent accuracy and makes the couples, as illustrated in Fig. 5, may be used to reduce the high cost of the platinum-rhodium element. The inexpensive alloys employed for the extension of the couple are such that the two secondary thermo-electric effects at the junctions with the plati-

FIG. 4.—CHART OF WM. H. BRISTOL RECORDING PYROMETER.

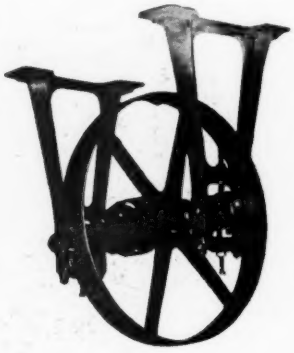
operation of the instrument an easy matter. The protecting case containing the galvanometer is hinged to the back of the recorder, and in Fig. 3 is shown turned to one side. This arrangement prevents injury to the recorder arm, while the charts are being changed or the clock wound.

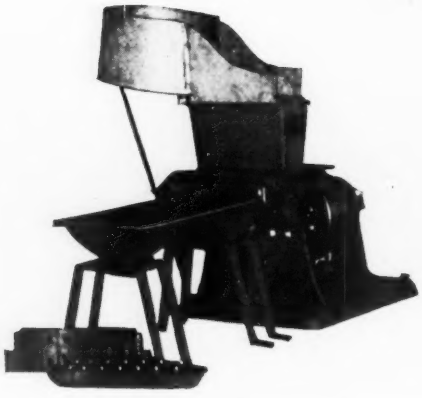
It should be mentioned that the coating of lamp black on the charts is not sufficient to obscure the graduations, and the edges and center are unsmoked. The charts can, therefore, be conveniently handled and packed for shipment. The couples employed for ranges not exceeding 2000 degrees Fahr. are made of special alloys, which are inexpensive, and may be of almost any desired form or length to suit the special requirements. For ranges above 2,000 degrees Fahr., the standard Le Chatelier platinum-rhodium elements are used. Compound num and platinum-rhodium elements neutralize each other if the temperature at these junctions does not exceed 1,200 degrees Fahr. The indications on the instrument will be the same as if the whole couple had been made of the more expensive metals. Where there are varying temperatures at the cold end of the couple, a mercury compensator is used, which automatically changes the resistance of the circuit, so that no correction is necessary for the working range of the instrument.

AN IMPROVED CORE MACHINE.

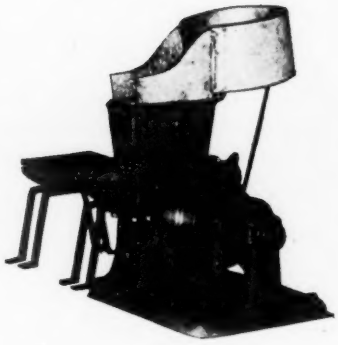
The tendency in all foundry practice at present is to eliminate as much hand work as possible, and where this can be accompanied by more accurate castings and better work, such improvements are certainly to be welcomed. All hardware and lock manufacturers are acquainted

with the difficulty of obtaining small square cores for use in connection with locks, door-knobs, etc. To solve this problem George H. Wadsworth of the Falls Rivet & Machine Co., has designed a core machine as shown in the accompanying illustrations. The sand hopper and sand feed are similar to those in his standard machines. The feed screws are also so arranged as to use standard vent wires. The design of the feed screws, however, has been altered, each being provided with a hardened tool steel tip, which is so constructed that it locks into the regular feed screw forming positive drive. The cores produced by this machine are .295 of an inch on a side, and are vented from end to end with a hole about 1-16 of an inch in diameter. There are six openings from which cores are ejected simultaneously. The cores pass out onto a plate which is designed to receive 24 cores. After six cores have been forced out the plate is moved sidewise and six more run out; four such operations being necessary to fill a plate. The driving belt runs continuously in one direction, and the machine is started and stopped by means of a friction clutch, shown at the right of the machine, this friction clutch being controlled by a foot-lever or treadle. On account of the fine surface finish which the machine gives to these cores, it is possible to produce more accurate holes than can be produced with hand-made cores.





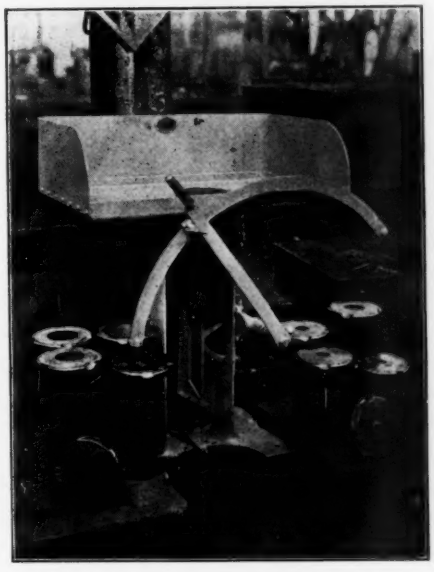
AN IMPROVED CORE MACHINE SHOWING CORE PLATE AND DUPLICATE DIES.



AN IMPROVED CORE MACHINE SHOWING FRICTION DRIVE.

THE LEEDS DEAD LENGTH CORE MACHINE.

In England and on the continent core machine makers have turned their attention mainly to the production of core machines of the type shown in the accompanying illustration. These are really core boxes arranged with special facilities for making changes in the size of the core, in removing it from the mold, etc.



LEEDS DEAD LENGTH CORE MACHINE

The machine consists of a table or bench in the center of which the core box is arranged or mounted. The bench is supported upon a strong cast iron pillar, which also carries the necessary gear for operating the piston. The various molds are very quickly changed, the connection with the machine being made by simple bayonet joints. A half turn of the hand being all that is necessary to secure the mold in position. The method of operating the machine is as follows:

A list of different cores required is made out and given to the coremaker. He then selects a mold of the proper diameter and sets the adjustable stop to the length of the core. It will be noticed that on the front of the machine there is a quadrant upon which is clamped a stop. By adjusting this stop the limits of the piston travel may be fixed so as to produce any desired length of core within the capacity of the machine. Core or ordinary molding sand is then rammed into the mold and the venting attended to with a vent wire in the usual manner. A few blows from a mallet on the mold loosens the core, and by throwing the lever to the right the core is forced out of the mold or box.

Boxes for producing round, square or any other prismatic form of core may be employed.

The use of the quadrant and stop is especially advantageous as it permits changes from one length of core to another to be made very quickly.

The machine may also be fitted for forming a large vent or opening through the center of large cores. For instance, cores six inches in diameter by 15 inches long with a two-inch hole in the center may be formed. This not only provides for ample venting of the core, but reduces the amount of core material which has to be used. In the case of some of the smaller sizes a vent wire may be attached to the piston, which forms a vent through the core while it is being rammed.

The table in the machine shown is 21 by 30 inches. By the use of this machine an operator may turn out many more cores than it would be possible with ordinary boxes on account of the saving of time in making changes, venting the cores and removing the same from the molds.

The makers claim that from 60 to 80 cores two inches in diameter and six inches long can be made by a boy in an hour. The machine may also be fitted with an attachment for making cores up to 12 inches in diameter by 15 inches long. The makers claim that no special core sand or mixture is necessary with this machine. The machine is being placed on the market by Horace P. Marshall & Co., Leeds, England.

TRADE NOTES.

The McPhail Flask & Machine Co., Chicago, Ill., has been incorporated with a capital stock of $50,000 by J. H. Thomas, Gladys L. Eastman and R. B. MacPhail.

The Buffalo Forge Co, Buffalo, N. Y., manufacturing engines, pumps, heaters, ventilating apparatus, etc., has increased its capital from $1,000,000 to $1,250,000. This increase will be applied to the enlargement of its works at Broadway and Spring streets.

The Curtis & Co. Mfg. Co., St. Louis, Mo., is planning to increase its capital stock from $250,000 to $500,000.

The Penn Steel Casting & Machine Co., Chester, has closed contracts through Powell & Colne, 11 Broadway, New York, for two two-ton Tropenas converters. The Duquesne Steel Foundry Co., Coraopolis, Pa., is also to install a converter and equipment in the addition to its foundry.

The Ajax Metal Co., Philadelpha, has taken out a permit to erect a one-story brick addition to its foundry on Frankford avenue to cost $7,000.

The Buffalo Blower Co., Buffalo, has been organized with a capitalization of $10,000 by William F. Wendt, Henry W. Wendt and Wilbur F. S. Lake.

Stanley Daggett, of New York, manufacturer of the Perfection parting compound, reports unusually heavy sales from the Chicago district in particular, though the sales are increasing all over the country. He calls attention to the fact that where manufacturers formerly purchased only a few pounds of parting compound for their more difficult castings, they now purchase in 1,000 pound lots and use it for all classes of work, as it has been found more efficient and cheaper than the common and natural products.

The W. W. Sly Mfg. Co., of Cleveland, has received such a large volume of orders that it has been necessary to erect a new machine shop, which will for the present be devoted entirely to the manufacture of steel cases for dust arresters, as this business is rapidly growing. It has also been necessary to erect a new foundry, which will, for the present, be devoted entirely to the manufacture of chilled stars for cleaning castings. This step was made necessary on account of the fact that the malleable foundries, from which these castings have formerly been obtained, are all so busy that they cannot give prompt delivery.

Messrs. Powell & Colne, 11 Broadway, New York city, agents for the Tropenas converter steel process, which is being generally introduced in this country for the manufacture of small and medium steel castings, have closed a contract for a new two-ton Tropenas converter with the Reading Steel Casting Co., Reading, Pa., where they first installed the process for the then Brylgon Steel Casting Co.

Geo. W. Douglas, who for the past two years has been connected with the sales department of Rogers, Brown & Co., Cincinnati, will on Jan. 1, 1907, occupy a similar position with their St. Louis office.

Fred W. Bauer, for two years past connected with the St. Louis office of Rogers, Brown & Co., will return Jan. 1, 1907, to Cincinnati and represent Rogers, Brown & Co. in the same territory as before going to St. Louis in 1905.

The Norton Grinding Co., Worcester, Mass., is planning extensive additions to its works, including the erection of a new building, 86 x 278 feet, one story, to be a duplicate of the present shop.

L. A. Wyman has accepted a position in the sales department of the Dayton Pneumatic Tool Co., with headquarters at Dayton, O.

The Piqua Blower Co., Piqua, O., formerly the Piqua Foundry & Machine Co., is enlarging its equipment for the better handling of its output of positive blowers. The increased demand for this blower has led the company to make a specialty of its manufacture.

TRADE PUBLICATIONS.

C. W. Leavitt & Company, No. 22 Broadway, New York City, have issued a very attractive calendar which will be highly appreciated by many who have found pleasure and recreation during the summer in automobile tours. The picture at the top is entitled "A Sure Thing," and represents a good, trusty old farm-horse bringing a dead automobile into town. While the farmer and his dog head the procession, the would-be pleasure seekers in the touring car look rather bored. Below the picture there is an advertisement stating that the company are importers and agents for foreign ores, metals, and alloys for iron, steel and brass works, and also for chemicals for glass works.

De Camp Brothers & Yule Iron, Coal & Coke Co., of St. Louis and Chicago, are sending out a very striking calendar at the top of which there is an illustration of two men pouring snap flasks from hand ladles. The picture is in black and red, and is very well executed. Beneath there is a good-sized calendar pad, having white letters on a black ground.

PERSONALS.

W. S. Allen, superintendent of the Sharon Foundry Co., Sharon, Pa., has resigned and will locate in Pittsburg.

Lovett T. Scofield has been elected president of the Federal Mfg. Co., Columbus, O., to succeed the late Charles W. Currier.

M. W. Sees has disposed of his interest in the Sees foundry, Portland, Ind., to Sixby & Crumme, and will retire from the business with which he has been connected for 38 years.

L. A. Carlisle, manager of the Bessemer Soil Pipe Works, Bessemer, Ala., has resigned after holding that position about a year. He will be succeeded Dec. 1 by W. S. Todd, of Chattanooga.

Thos. F. McDonald has become foreman of the new brass foundry of the Platt Iron Works, Dayton, O. Mr. McDonald was formerly connected with the Bullock Electric Co., Cincinnati, and later with the Monarch Engineering & Mfg. Co., of Baltimore, Md.

W. H. Lindelsee has been made superintendent of the Marion Malleable Iron Works, Marion, Ind. He has heretofore been foreman of the pattern shop.

Chas. J. Caley, who has been general superintendent of the Russell & Erwin Mfg. Co., New Britain, Conn., for the past five years, has been made general manager.

W. C. Crowe, assistant superintendent of the Aetna Foundry & Machine Co., Warren, O., has been made general superintendent to succeed Sherman T. Penney, resigned.

Charles J. Mesta, vice president of the Mesta Machine Co., of West Homestead, Pa., was recently elected to represent his district in the next legislature.

R. L. Reel, formerly superintendent of the Sodeman Heat & Power Co., Edwardsville, Ill., has become superintendent of the Belleville Foundry Co., Belleville, Ill.

DEATHS.

John R. Blakeslee, president of the Ajax Mfg. Co. and of the Blakeslee Foundry & Forging Co., Cleveland, died Nov. 9 at his home in that city after a prolonged illness. He was a native of Connecticut and a veteran of the civil war, locating shortly after its close at Indianapolis, then removing to Youngstown and finally to Cleveland in 1878. Shortly after that he founded the Ajax company, of which he was the head, though of late his son, John R. Blakeslee Jr., has been in charge of the business. He was at one time mayor of Glenville, a suburb of Cleveland, but refused other political honors.

Louis W. Krueger, proprietor of a brass foundry in Buffalo, died Nov. 11 as the result of injuries sustained by being run down by a train.

Richard N. Barnett, proprietor of the Brass Founders' Supply Co., Newark, N. J., died Nov. 30. He was the

father of Stephen D. Barnett, president of the Barnett Equipment Co., of the same city.

Henry J. Hendey, president of the Hendey Machine Co., Torrington, Conn., died Dec. 8, at the age of 62, after an illness of several months. Mr. Hendey was one of the pioneer manufacturers of Torrington and with his brother, Arthur J. Hendey, was the chief factor in the organization of the Hendey Machine Co., of which he had been president since 1883. He is survived by a widow, two daughters and a brother.

J. W. Dunham, senior member of the firm of J. W. Dunham & Son, manufacturing agricultural implements at Berea, O., died Dec. 13, at the age of 72. Mr. Dunham was born at Hinckley, O., March 10, 1834. He had been engaged in the manufacture of agricultural implements for the past 44 years, commencing in this business at Hinckley in 1862, and removing in 1889 to Berea, O. His son, W. J. Dunham, became associated with him in this business in 1882. Mr. Dunham had been in poor health for the past year, though his death, which was due to heart failure, was sudden. Funeral services were held at the Congregational church, Berea, Dec. 16. He is survived by his widow, a son, W. J. Dunham, a daughter and sister.

FIRES.

W. H. Drake's iron foundry, at Hackettstown, N. J., was destroyed on Nov. 21, the loss being estimated at $2,000.

The plant of the Nampa Foundry & Machine Co., Nampa, Idaho, was destroyed by fire on Nov. 27, with a loss of $35,000, partly covered by insurance.

The foundry of Timms Bros., Interlaken, N. Y., burned Nov. 19.

NEW CONSTRUCTION.

Stanton Griffith, foundry superintendent for Fairbanks, Morse & Co., and D. H. Foster, formerly of Beloit, Wis., have leased the South Avon street foundry, Rockford, Ill., for a term of four years and will begin operations Jan. 1. A jobbing business will be conducted and the Griffith molding machine will be manufactured.

The Lakeside Malleable Castings Co., of Racine, Wis., is making improvements which will double the capacity of its plant. The new buildings include an annealing house, 70 x 240 feet, two foundries, 70 x 180 feet, office building and power plant, all of fireproof construction.

The Mereen-Johnson Machine Co., Minneapolis, Minn., will spend about $50,000 in building and equipping their foundry.

The Brady Brass Co., of Jersey City, N. J., is increasing the capacity of its plant by a large addition and the installation of new machinery.

The Cockburn Barrow & Machine Co., which is to be consolidated with the Stayman Mfg. Co., is erecting a plant at Twelfth, Thirteenth and Monmouth streets, Jersey City, N. J. The buildings will include a machine shop and pattern shop.

The Florence Iron Works, Florence, N. J., is constructing a new foundry for the manufacture of water pipe.

The Empire Foundry Co., New Brunswick, N. J., is adding to its plant a brick building, 60 x 142 feet, two stories high, for the manufacture of gas stoves and appliances.

The Atha Steel Casting Co., Newark, N. J., has recently completed three 30-ton open-hearth furnaces and other large additions to its foundry and can now produce over 3,000 tons of open-hearth steel castings per month, with further extensions possible whenever needed. It will also continue to use small converters for the production of small castings.

Permission has been granted by the city of New Orleans, La., to Frank Dominique & Co. to establish and operate a foundry on Erato street, in that city.

A. Olshon will erect a brick foundry at Independence avenue and the Kansas City Southern railroad, Kansas City, Mo., at a cost of $3,000.

I. Levinstein & Co., Davenport, Ia., expect in the spring to erect a new building, 100 x 200 feet, also pattern shop and coremaking room, with the idea of manufacturing gray iron castings and pipe.

The Orange Iron Works, Orange, Tex., will erect a small foundry.

The Nordeen Iron Works, Everett, Wash., has purchased a tract of land on which it will erect a foundry and machine shop, the latter to be largely employed in the construction of engines.

The National Machinery Co., Los Angeles, Cal., is building a new plant, including a foundry 80 x 150 feet.

R. P. Clark and associates, of Galveston, Tex., are planning to spend about $400,000 in the construction and equipment of a dry dock, pumping station, power house, machine shop and foundry.

The Red Jacket Mfg. Co., maker of pumps and pump supplies, Davenport, Ia., has awarded the contract for a new foundry to cost about $25,000. The new building will be 80 x 200 feet, adjoining the present foundry, and will double the capacity of the plant.

The Frank H. Lamb Machine Co., Hoquiam, Wash., is to increase its foundry by a two-story structure 40 x 80 feet.

C. H. Schasteen and John Ruhl are planning to open a foundry in the old Parrott stove building, Carthage, Mo.

L. J. Binder, an experienced patternmaker, has opened a pattern shop on the corner of Scott street and Pacific avenue, Spokane, Wash., to be run in connection with the New York Brass & Bell Metal Works.

The Hart-Parr Co., Charles City, Ia., will double the capacity of its foundry in order to increase its output of gasoline engines.

The MacGregor-Gourlay Co., of Galt, Ont., has laid the foundations for a molding shop 140 x 210 feet.

The Canadian Iron & Foundry Co. is building an extensive plant at Fort William, Ont., which is to be devoted especially to the manufacture of railway car wheels and cast iron water and gas pipe.

The Robertson Machine Co., Welland, Ont., is planning extensive additions, including a foundry and machine shop.

The Waterbury Brass Co., Waterbury, Conn., is making extensive improvements, including the erection of a large casting shop.

L. G. Knight & Son, Gardner, Mass., have completed their new plant, consisting of a machine shop, 60 x 150 feet, and a foundry, 40 x 100 feet.

The American & British Mfg. Co., Providence, R. I., builder of steam and combustion engines, is making extensive improvements, and will later on erect a new foundry.

The Chapman Valve Mfg. Co., Indian Orchard, Mass., will increase its capitalization from $600,000 to $800,000 in order to care for extensive new construction work and other improvements.

The Ellsworth Foundry & Machine Works, Ellsworth, Me., recently incorporated with a capital stock of $25,000 by J. A. Peters and Chas. Peters, is increasing the capacity of its foundry plant and erecting a building for pattern storage.

The Sweet & Doyle Valve Co., Albany, N. Y., has purchased the building of the Troy Laundry Machine Co., on Center street, and is making extensive improvements to the building. A foundry will be installed.

The General Railway Signal Co. has moved from Buffalo to Rochester, N. Y., having sold its Buffalo plant. Important additions will be made to the Rochester plant, where additional land will probably be purchased.

C. C. Bradley & Son, Syracuse, N. Y., will build an addition to their plant on North Franklin street for the manufacture of gray iron castings. It will be of steel and concrete construction 60 x 150 feet.

The Riverside Foundry, Wrightsville, Pa., has broken ground for a building 45 x 100 feet.

The Reading Steel Casting Co. has arranged to double the size of its plant at Reading, Pa. This plant was formerly occupied by the old Brylgon Steel Casting Co.

The Chester Steel Casting Co., Chester, Pa., has let the contract for an extension to its open-hearth foundry

The Quincy Engine Co. is enlarging its plant in Quincy, Franklin county, Pa. A brick foundry is being erected, a large addition will be made to the machine shop and a new cupola will be built.

The Treadwell Co. is adding a small foundry to its plant at Lebanon, Pa.

The gray iron foundry of the Baldwin Locomotive Works, at Eddystone, Pa., is practically completed. It is 200 x 350 feet, built entirely of structural steel and terra cotta.

The Philadelphia Stove & Foundry Co., Philadelphia, is making extensive improvements and will add to its stove business the manufacture of auto cylinders and gasoline engines.

The Philadelphia Pipe Co., Bristol, Pa., has begun the erection of a foundry plant on which it will expend about $75,000.

The Hermance Co. has broken ground for an addition to its plant at Williamsport, Pa. A new foundry will be built at once to handle the increasing business of the company.

The Hockensmith Wheel & Mine Car Co., Penn Station, Pa., is building a 40 x 50-foot addition to its molding department.

The Williamson Mfg. Co., Bradford, Pa., has increased its capital stock from $50,000 to $75,000, and according to reports, will erect a new foundry building.

George W. Miller, of Reading, Pa., will build an addition to his foundry on Penn street. The main building will be 35 x 40 feet, two stories high, of brick, with an addition 29 x 70 feet.

The Lorain Steel Co., Philadelphia, is planning to spend about $200,000 in new construction and improvements at its Johnstown plant. The company recently completed an extension, 54 x 180 feet, to its steel foundry building.

The Sharon Foundry Co., Wheatland, Pa., has closed down its plant for repairs.

The Lorain Casting Co., recently incorporated, will build a foundry of about 25 tons per day capacity at Lorain, O. This will be run on custom work, supplying local interests. H B. Davidson, for many years superintendent of the Lorain Foundry Co., will be in charge of the plant.

The Central Steel Casting Co., Columbus, O., which is being organized by J. V. L. Bonney to manufacture steel castings for the general trade, has a number of sites under option and work on the new plant will be begun within a short time. The plant will have a capacity of 500 tons of steel castings a month.

The American Foundry & Machine Co., Hamilton, O., will construct an addition to its plant.

The Cincinnati Milling Machine Co. will erect a new plant at Oakley, a suburb of Cincinnati. The foundry building will be 350 x 450 feet, the pattern shop 50 x 160 feet and the power house 75 x 100 feet.

The Butler Foundry Co., Hamilton, O., a custom foundry for gray iron castings, is planning the extension of its present plant.

The Patric Furnace Co., Springfield, O., will erect a large foundry, 65 x 125 feet, of brick and steel construction.

The International Harvester Co. will open its branch foundry at Springfield, O., about Jan. 1. It has not been in operation for some time.

The Standard Foundry Co., Cleveland, has let a contract for additions to its plant.

George D. Todd, of the Todd Mfg. Co., New Albany, Ind., is considering plans for the erection of a large malleable iron plant at New Albany, Ind. About $200,000 will be expended.

The Terre Haute Malleable Iron Co., Terre Haute, Ind., will soon have

its new plant in operation and expects by spring to employ a force of 300 men.

The Central Malleable Iron Co., of Decatur, Ill., is planning to begin the manufacture of steam and hot water heating plants.

The plant of the Sodemann Heat & Power Co., Edwardsville, Ill., recently destroyed by fire, is being rebuilt.

The new plant of the Northern Malleable Iron Co., St. Paul, Minn., is now practically completed. It includes a main building, 110 x 900 feet, of concrete and steel construction, pattern shop and fireproof pattern vault, each of concrete, 60 x 80 feet and 20 feet high, office building, sand sheds, etc. The total cost will be approximately $150,000. The working force will be increased to about 500.

The Wisconsin Malleable Castings Co., Milwaukee, has practically completed improvements which will double its present capacity. Two foundries, 70 x 180 feet, an annealing house, 70 x 240 feet, an office building and power plant have been erected.

The McDonough Mfg. Co., Eau Claire, Wis., is planning to erect a new foundry in the spring.

The Columbia Heights Foundry Co., Minneapolis, Minn., has completed another addition to its plant.

The Grand Rapids Malleable Iron Works, Grand Rapids, Mich., is making rapid progress in the reconstruction of its plant, recently destroyed by fire, and already had a large part of its old force employed.

The Draper Mfg. Co., Port Huron, Mich., is erecting an addition, 50 x 75 feet, which will be used for a molding room.

The Baldt Steel Co., New Castle, Del., has prepared plans and secured governmental permission for the construction of a pier 800 feet long and 100 feet wide reaching out into the Delaware river.

Estimates on the erection of a foundry building at Riverside, N. J., are being taken by the William Steel & Sons Co., of Philadelphia. The building will be of brick, two stories high, with floors of reinforced concrete. It will cover an area of 75 x 159 feet.

The new plant of T. Shriver & Co., Harrison, N. J., is now in operation and the entire equipment has been moved from its old location in East Fifty-sixth street, New York city, to the new plant.

The H. Wetter Mfg. Co., South Pittsburg, Tenn., is making an important addition to its foundry. The building will be 58 x 138 feet and will be equipped for the manufacture of soil pipe and fittings.

The Chickasaw Iron Works, Memphis, Tenn., has purchased a tract of five acres in North Memphis, upon which it will erect a branch plant, consisting of a foundry and structural shops, in which pattern work and steel molding will be done.

The Ross-Mehan Foundry Co., Chattanooga, Tenn., will erect a building, 60 x 200 feet, to be used as a pattern shop for storage purposes. A new annealing room at the plant has recently been completed.

George Wainwright, of Wilson, N. C., will rebuild that portion of his foundry which was recently destroyed by fire.

A new foundry and ornamental iron department 100 x 150 feet will be erected by the Sunset Iron Works, Los Angeles, Cal.

The Acme Malleable Iron & Foundry Co., recently organized at Puyallup, Wash., expects to have its new plant at Meeker Junction in operation by Jan. 1. The officers are: President, T. H. Bellingham; vice president, George K. Whitney; secretary and treasurer, Theodore Schenkenberg, all of Tacoma.

Stroud & Co., Omaha, Neb., are adding a foundry to their plant.

The Reeves Machine & Supply Co., Muskogee, I. T., is erecting a building in which it will install a machine shop and foundry.

The Hoquiam Machine Works, Hoquiam, Wash., is erecting a gray iron foundry, 40 x 80 feet, and will manufacture castings for its own machinery.

The new shops of the Camden Anchor-Rockland Machine Co., Camden, Mo., will be used for the manufacture of Knox marine and stationary gasoline engines. The company will move its brass and iron foundry from Rockland to Camden some time next year.

The Standard Gas Engine Co., Oakland, Cal., is constructing a building, 80 x 80 feet, adjoining its main works. This will be used as a foundry by Mr. Schimmelpfennig, who is moving his foundry equipment from Stockton to Oakland.

The Vulcan Iron Works, Ltd., Winnipeg, Man., has completed a brick and stone pattern shop.

GENERAL INDUSTRIAL.

The Fairfield Aluminum Foundry Corporation, of Fairfield, Conn., has been incorporated with a capital of $10,000. The incorporators are: John H. Robinson, of Bridgeport; W. Herbert Jennings, of Fairfield, and Everett E. Bulkeley, of Westport.

The E. G. Rippel Steel Foundry Co., Buffalo, has been incorporated with a capitalization of $50,000, with E. G. Rippel, J. V. Rippel and W. C. Miller, all of Buffalo, as directors. The O'Brien foundry plant at 31-39 Indiana street has been leased and put in order for the manufacture of steel castings of the smallest class by the crucible process. Oil furnaces will be used. E. G. Rippel recently disposed of his interests in the Buffalo Foundry Co. and in the Buffalo Crucible Steel Casting Co., both of which he organized. J. V. Rippel and W. C. Miller are also experienced foundrymen, the latter having been foundry foreman of the Buffalo Crucible Casting Co.

The Globe Malleable Iron Co., Syracuse, N. Y., which was organized in July last, is now producing about 10 tons daily of strictly high-grade malleable iron castings. Officers of the company are as follows: W. C. Lipe, president; A. T. Brown, vice president; S. J. Marshall, treasurer, and J. S. Pickell, secretary.

The Cast Iron Brazing Co., for brazing cast iron, has been incorporated with a capital stock of $12,000. The incorporators are: Charles B. Potter, Nathaniel R. Potter and Helen M. Hall, all of Rochester, N. Y.

Samuel Jackson, of Fayetteville, N. Y., has purchased the Fayetteville foundry property and will manufacture steam derricks, clutches and clutch pulleys.

Thomas J. O'Brien, proprietor of the O'Brien Foundry, Buffalo, recently leased to the E. G. Rippel Steel Foundry Co., has retired from the foundry business for the present.

The Model Brass Foundry, for manufacturing castings, tools, etc., has been incorporated by P. Popp, J. Popp and J. Epp, of Buffalo. The capital stock is $5,000.

The Millalsin Engineering & Foundry Co. has been incorporated at Sharon, Pa., by Frederick Millhouse, John Sinclair and Ernest W. Allen. A plant, with main building 50 x 100 feet, will be erected at once for the manufacture of brass castings, drop forgings, tools and machinery.

The American File Renewing Co., of Reading, Pa., mechanical engineer, toolmaker, founder, etc., has been incorporated with a capital stock of $50,000. The incorporators are: Maurice De Levante, Reuben S. Baldwin, Abraham Near, Charles Dickson and William H. Dodge, all of New York.

It is announced that the Niles-Bement-Pond Co. has acquired the plant of the Ridgway Machine Tool Co., Ridgway, Pa. The plant includes a main building, 187 x 255 feet; foundry, 112 x 150 feet; forge shop, 75 x 150 feet, and pattern storage building and pattern shop of the same size.

The Mitchell-Van Meter Foundry Co., Pottstown, Pa., is to double its capacity.

The Westinghouse Air Brake Co., Pittsburg, is making important extensions at its Wilmerding plant, including a two-story building, 50 x 125 feet, the second floor of which will be used for a core room.

WE **SOLD** OVER

45,000

Barrels Flour

in the past twelve months

Some one must be satisfied with the flour which they are getting, as well as the treatment accorded them, or we could not have done this amount of business.

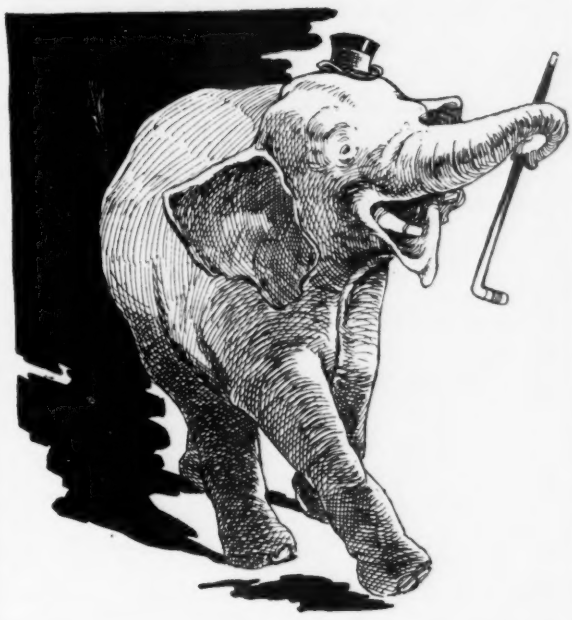
We are pleased to announce that we are now in shape to do double the amount of the above business in the future, as we have largely increased the capacity of our plant.

The Piqua Flour Co.

PIQUA, OHIO, U. S. A.

Alphabetical Index to Advertisers.

Adams Co. 16, 151
Addy, Matthew, & Co. 164
Ajax Metal Co. 158
American Air Compressor Works. 160
American Blower Co. 39
Arcade Mfg. Co. 20
Atlas Car & Mfg. Co. 145
Baird & West 165
Barnett, Oscar, Foundry Co. 33
Bartlett, N. S., & Co. 164
Basic Chemical Co. 157
Berkshire Mfg. Co. 17
Blackwell, Geo. G., Sons & Co. 159
*Blake, Geo. F., Mfg. Co. 156
Bonvillian, Ph., & E. Ronceray 18
Brass Founders' Supply Co. 146
Bridgeport Safety Emery Wheel Co. 138
Bristol Co. 163
Brown Specialty Machinery Co. 24
Burdick & Son. 146
*Byram & Co. 154
Carborundum Co. 138
Case Mfg. Co 144
Cherry Valley Iron Co. 44
Chicago Pneumatic Tool Co. 30
Clark Cast Steel Cement Co. 26
*Cleveland Fillet Co. 153
Columbus Iron & Steel Co. 164
Connersville Blower Co. Back cover
Cornell, J. B. & J. M., Co. 156
Curtis & Co. Mfg. Co. 41
Dalton, Nash & Co. 162
*Deane Steam Pump Co —
DeCamp Bros. & Yule Iron, Coal & Coke Co. 164
Detroit Testing Laboratory. 160
Diamond Clamp & Flask Co. 151
Dimmick, J. K., & Co. 164
Dings Electro Magnetic Separator Co. 150
Dixon, Joseph, Crucible Co. 40
Dobson, William. 163
Dodge & Day 163
Doggett, Stanley 153
Domhoff & Joyce Co. 164
Drucklieb, C. 137
Electric Controller & Supply Co. 147
Elliot, Debevoise & Anderson 165
Elm City Engineering Co. 150
Etting, Edward J. 161
Falls Rivet & Machine Co. 30
Field, Robt, Sales Agency. 165
Fox Machine Co. 161
Gautier, J. H., & Co. 46, 153
General Chemical Company. 160
General Pneumatic Tool Co. 133
Gilmour, J. 146
Goldschmidt Thermit Co. 147
Goodrich, F. A., & Co. 164
Gregg Company 144
Gunn, Richards & Co 129
Hanna Engineering Works. 31
Harbison-Walker Refractories Co. 161
Harrington Son & Co., Edwin. 143
Hawley Down Draft Furnace Co 42
Herman Pneumatic Machine Co. 21
Hill & Griffith Co. 5
Hillman, J. H., & Son. 164
Hooper, G. K. 163
Independent Pneumatic Tool Co. 133
Ingersoll-Rand Co 34
Jones & Attwood. 157
Joy Detective Service 163
Keep, W. J 160
Kendall & Flick 158
*Kent Mfg. Co. 22
Lane, H. M. 149
Library Bureau 131
Lindsay, W. W., & Co. 37
Loughry, James C. 138
MacKellar's Sons Co. 151
Manning, Maxwell & Moore 142
Maris Bros. 141
Maurer, Henry & Son. 160
Maywood Foundry & Machine Co. 19
McCormick, J. S., Co. 8
McCullough-Dalzell Crucible Co. 48
McKeefrey & Co. 164
Metallurgical Laboratory. 160
Mfg. Equipment and Engineering Co. 132
Middleditch, Benj. 151
Midvale Mining & Mfg. Co. 158
Millett Core Oven Co. 23
Mills, C. E., Oil Co. 50
Mohr, J. J. & Son. 164
Monarch Engineering & Mfg. Co. 43
Mumford, E. H. Co. 12, 13
National Jeloluse Co. 157
New Era Mfg. Co. 159
Newport Sand Bank Co. 148
Niles-Bement-Pond Co. 144
Northern Engineering Works 141, 142
Norton Company 137
Norwalk Iron Works Co. 150
Obermayer, S., Co Inside front cover
Osborn Mfg. Co. 139
Otis Steel Co. 152
Pangborn, T. W. Co. 9
Partamol Co. 153
Pawling & Harnischfeger. 143
Paxson, J. W., Co. 2, 3, 4
*Pettinos Bros. 28
Phosphor Bronze Smelting Co. 158
Pickands, Brown & Co. 165
Pickands, Mather & Co. 165
Pilling & Crane. 165
Piqua Blower Co. 155
Piqua Flour Co. 123
Pridmore, Henry E. 10, 11
Randall, R. T., & Co. 140
Ransom Mfg. Co. 137
Rathbone, John A. 13
Ridgway, Craig, & Son Co. 32
Robeson Process Co. 1
Rockwell Engineering Co. 148
Roessler & Hasslacher Chemical Co. 159
Rogers, Brown & Co. 165, 166
Roots, P. H. & F. M., Co. Insert
Ross-Tacony Crucible Co. 49
Seidel, R. B. Inc. 156
Sellers, Wm., & Co. 45
Shanafelt Mfg Co. 29
Shelton Metallic Filler Co. 25
Shepard, Chas. G. 165
Shuster, F. B., Co. 152
Sly, W. W., Mfg. Co. 35
Smith, J. D., Foundry Supply Co. 6, 7
Smooth-On Mfg. Co 27
Standard Sand & Machine Co. 149
Sterling Oil Co. 157
Stevens, F. B. 125, 127, 165
Stephens & Co 155
Stow Mfg. Co. 138
Sturtevant, B. F., Co. 38
St. Louis & San Francisco R. R. Co. 154
*Surplus Coke Co. —
Tabor Mfg. Co. 14, 15
Taylor, A. L. 163
Taylor, Robert J., Inc. 47
Thomas Furnace Co. 165
Tilghman-Brooksbank Sand Blast Co 135
Turner Machine Co 125
United States Graphite Co. 152
Walter-Wallingford & Co. 165
Watt Cupola Twyer Co. 167
Western Foundry Supply Co. 159
Whiting Foundry Equipment Co. 52
Wiener Co., Ernst. 125
Wonham & Magor. 139
Yale & Towne Mfg. Company 145
Young, Frank L., & Kimball 51



The sunshine and shadows of 1906 have passed into History.

Each year renders its quota of great successes and of bitter failures.

Those of us now on the right side of the earth have become a little better equipped; a little more competent through experience to carry on our mission.

My trade mark, ELEPHANT, appears just a little gay, still harmless enthusiasm in a good cause is allowable. A New Year means a new effort, or renewed effort, towards the desired accomplishment.

On the new leaf which I am to turn over I would like to add the names of a few more satisfied foundrymen---a few more contented buyers of Polishers' and Platers' Compositions and of Foundry Facings and Supplies, all of which material I manufacture, and I will then endeavor to give them all good service; better than the best if it is possible. I manufacture a long line, still I always need greater opportunity to demonstrate my claims.

Will you write me about your side of the story?

Frederic B. Stevens,

Cor. Larned & Third Sts.,

DETROIT, MICH.

CLASSIFIED

BUYERS' DIRECTORY

Advertisers' names are inserted under this heading at the rate of four classifications to each page advertisement carried regularly.

Abrasive Materials:
Carborundum Company, Niagara Falls.
Norton Company, Worcester, Mass.

Accountants.
Gunn, Richards & Co., New York.
Library Bureau, Systematizing Dept., Boston.

Air Compressors:
American Air Compressor Works, New York.
Independent Pneumatic Tool Co., Chicago.
Chicago Pneumatic Tool Co., Chicago.
Curtis & Co. Mfg. Co., St. Louis.
Independent Pneumatic Tool Co., Chicago.
Ingersoll-Rand Co., New York.
Norwalk Iron Works Co., So. Norwalk, Conn.

Alloys:
Blackwell Sons & Co., Geo., Ltd., Liverpool, Eng.
New Era Mfg. Co., Kalamazoo, Mich.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.

Analysis—Mechanical:
Keep, W. J., Detroit.

Analysis—Chemical:
Detroit Testing Laboratory, Detroit.
Metallurgical Laboratory, Pittsburg.

Anchors:
Lindsay & Co., W. W., Philadelphia.

Babbitt Metal:
Ajax Metal Co., Birmingham, Ala.
New Era Mfg. Co., Kalamazoo, Mich.

Black Lead:
United States Graphite Co., Philadelphia.

Blowers:
American Blower Co., Detroit.
Connersville Blower Co., Connersville, Ind.
Cornell Co., J. B. & J. M., New York.
Monarch Engineering & Mfg. Co., Baltimore.
Paxson Co., J. W., Philadelphia.
Piqua Blower Co., Piqua, O.
Roots Company, P. H. & F. M., Connersville, Ind.
Sturtevant Co., B. F., Boston.

Blowers—Positive Pressure:
Connersville Blower Co., Connersville, Ind.
Piqua Blower Co., Piqua, O.
Roots Company, P. H. & F. M., Connersville, Ind.
Sturtevant Co., B. F., Boston.

Brakes (Electric):
Electric Controller & Supply Co., Cleveland.

Brushes:
Osborn Mfg. Co., Cleveland.

Buildings (Struct. Steel):
Lindsay & Co., W. W., Philadelphia.

Burners (Oil):
Monarch Engineering & Mfg. Co., Baltimore.

Carbonese:
Midvale Mining & Mfg. Co., E. St. Louis, Ill.

Castings (Steel):
Otis Steel Co., Ltd., Cleveland.

Cement (Furnace):
Dixon Crucible Co., Jos., Jersey City.
Gautier & Co., J. H., Jersey City.

Cement (Metallic):
Clark Cast Steel Cement Co., Shelton, Conn.
Shelton Metallic Filler Co., Derby, Conn.
Shanafelt Mfg. Co., Canton, O.
Smooth-On Mfg. Co., Jersey City.

Chaplets:
Burdick & Son, Albany.
Lindsay & Co., W. W., Philadelphia.
Shanafelt Mfg. Co., Canton, O.

Coke:
Rogers, Brown & Co., Cincinnati.
Surplus Coke Co., New York.

Controllers (Electric):
Electric Controller & Supply Co., Cleveland.

Cores:
Brown Specialty Machry. Co., Chicago.

Core Binders:
Mills Oil Co., C. E., Syracuse.
National Jeloluse Co., New York.
Robeson Process Co., Camden, N. J.
Sterling Oil Co., Emlenton, Pa.

Core Compounds:
Young, Frank L. & Kimball, Boston.

Core Machines:
Brown Specialty Machry. Co., Chicago.
Falls Rivet & Mch. Co., Cuyahoga Falls, O.
Jones & Atwood, Stourbridge, Eng.
Kent Mfg. Co., Kent, O.

Core Tapering Machines:
Brown Specialty-Machinery Co., Chicago.

Core Ovens:
Atlas Car & Mfg. Co., Cleveland.
Falls Rivet & Mch. Co., Cuyahoga Falls, O.
Millett Core Oven Co., Brightwood, Mass.
Paxson Co., J. W., Philadelphia.
Pangborn Co., Thos. W., New York.
Smith Foundry Supply Co., J. D., Cleveland.

Core Oven Recording Thermometer:
Bristol Co., Waterbury.

Cost Keeping Systems.
Gunn, Richards & Co., New York.
Library Bureau, Systematizing Dept., Boston.
Loughry, James C., Elyria, O.

Cranes:
Case Mfg. Co., Columbus, O.
Curtis & Co. Mfg. Co., St. Louis, Ill.
Manning, Maxwell & Moore, New York.

Continued on page 128

STEVENS SILVER FINISH

STEVENS SILVER FINISH

¶ The success of the stove making fraternity throughout this great and glorious country may be due in part to the way they dress up things with nickel plated trimmings.

¶ The beauty of any nickel plate is greatly enhanced by the use of STEVENS' SILVER FINISH. Wherever a brilliant finish is required nothing else is as good---especially where there are deep backgrounds liable to be filled, particles so left are easily washed out.

¶ It gives pocket-book satisfaction. I manufacture a complete line of Polishing and Plating Compositions. Samples sent without charge, and by express prepaid.

I manufacture also, EMERY CAKE, in which I use genuine imported TURKISH EMERY. ENGLISH CROCUS COMPOSITION made with use of imported materials. SPANISH FELT WHEELS—pure felt—Goods of quality only

Frederic B. Stevens

Corner Larned and Third Streets

DETROIT, MICH.

CRANES—Continued.

Maris Bros., Philadelphia.
Niles-Bement Pond Co., New York.
Northern Engrng. Works, Detroit.
Pawling & Harnischfeger, Milwaukee.
Ridgway & Son, Craig, Coatesville, Pa.
Sellers & Co., William, Inc., Philadelphia.
Whiting Foundry & Equipment Co., Harvey, Ill.

Crucibles:

Dixon Crucible Co., Jos., Jersey City.
Taylor, A. L., San Francisco.
Gautier & Co., J. H., Jersey City.
McCullough-Dalzell Crucible Co., Pittsburg.
Monarch Engineering & Mfg. Co., Baltimore.
Paxson Co., J. W., Philadelphia.
Ross-Tacony Crucible Co., Philadelphia.
Seidel, R. B., Inc., Philadelphia, Pa.
Taylor, Robt. J., Inc., Philadelphia.

Cupolas:

Byram & Co., Detroit.
Gilmour, J., New York.
McCormick Co., J. S., Pittsburg.
Northern Engnrng Works, Detroit.
Paxson Co., J. W., Philadelphia.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Linings:

McCormick Co., J. S., Pittsburg.
Paxson Co., J. W., Philadelphia.

Curbing (Foundry):

United States Steel Piling Co., Chicago.

Drills:

Chicago Pneumatic Tool Co., Chicago.
Independent Pneumatic Tool Co., Chicago.

Elevators:

Chicago Pneumatic Tool Co., Chicago
Curtis & Co. Mfg. Co., St. Louis.
Ridgway & Son, Craig, Coatesville, Pa.

Engines (Steam):

American Blower Co., Detroit.
Sturtevant Co., B. F., Boston.

Engineers (Foundry, Mech., Elec., &c.):

Dodge & Day, Philadelphia.
Hooper, Geo. K., New York City.
Lindsay & Co., W. W., Philadelphia.

Facings:

Dixon Crucible Co., Jos., Jersey City.
Doggett, Stanley, New York.
Hill & Griffith Co., Cincinnati.
R. MacKellar's Sons Co., Peekskill, N. Y.
McCormick Co., J. S., Pittsburg.
Obermayer Co., S., Cincinnati.
Paxson Co., J. W., Philadelphia.
Pettinos Bros., Bethlehem, Pa.
Smith Foundry Supply Co., J. D., Cleveland.
Stephens & Co., Kidwelly, Eng.
Stevens, F. B., Detroit.
Western Foundry Supply Co., E. St. Louis, Ill.

Fans:

American Blower Co., Detroit.

Ferro-Manganese:

Kendall & Flick, Washington, D. C.
Rogers, Brown & Co., Cincinnati.

Ferro-Silicon:

Roessler & Hasslacher Chemical Co., New York.
Rogers, Brown & Co., Cincinnati.

Fillers (Metallic):

Clark Cast Steel Cement Co., Shelton, Conn.
Shanafelt Mfg. Co., Canton, O.
Shelton Metallic Filler Co., Derby, Conn.
Smooth-On Mfg. Co., Jersey City.

Fillets:

Cleveland Fillet Co., Cleveland, O.
Shanafelt Mfg. Co., Canton, O.

Fire Brick:

Gautier & Co., J. H., Jersey City.
Harbison & Walker, Pittsburg.
Maurer & Son, Henry, New York.
Paxson Co., J. W., Philadelphia.

Fire Sand:

Carborundum Co., Niagara Falls, N. Y.

Flasks:

Adams Co., Dubuque, Ia.
Barnett Fdy. Co., Oscar, Newark.
Brass Founders' Supply Co., Newark.
Middleditch, Benj., Detroit.

Flasks (Snap):

Adams Co., Dubuque, Ia.
Diamond Clamp & Flask Co., Richmond, Ind.
Obermayer Co., S., Cincinnati.
Paxson Co., J. W., Philadelphia.

Flour:

Piqua Flour Co., Piqua, O.

Flux:

Basic Chemical Co., Evansville, Ind.

Foundry Equipment (Iron & Brass):

Barnett Fdy. Co., Oscar, Newark.
Etting, Edward J., Philadelphia.
Obermayer Co., S., Cincinnati.
Pangborn Co., Thos. W., New York.
Sly, W. W. Mfg. Co., Cleveland.
Standard Sand & Machine Co., Cleveland.
Stevens, F. B., Detroit.
Taylor, Robert J., Inc., Philadelphia.
Wiener Co., Ernest, New York.

Foundry Supplies:

A. L. Taylor, San Francisco.
Hill & Griffith Co., Cincinnati.
McCormick Co., J. S., Pittsburg.
Obermayer Co., S., Cincinnati.
Osborn Mfg. Co., Cleveland.
Pangborn Co., Thos. W., New York.
Paxson Co., J. W., Philadelphia.
Shanafelt Mfg. Co., Canton, O.
Smith Foundry Supply Co., J. D., Cleveland.
Stevens, F. B., Detroit.
Taylor, Robert J., Inc., Philadelphia.

Flux:

Basic Chemical Co., Evansville, Ind.

Furnaces (Melting):

Barnett Foundry Co., Oscar, Newark, N. J.
Hawley Down Draft Furnace Co., Chicago.
Monarch Engineering & Mfg. Co., Baltimore.
Paxson Co., J. W., Philadelphia.
Rockwell Engineering Co., New York.

Graphite:

United States Graphite Co., Philadelphia.

Continued on page 130

The Cost of It

The expense of a modern system of cost-keeping need be no greater than a crude, antiquated and inefficient way of keeping accounts.

Such a system is accurate, quick and in ample detail, and it gives the detailed costs of every part of the work while the business is fresh—when it is most valuable as a basis of comparison.

We have studied cost-keeping very carefully and have installed systems which meet these requirements in many well-known foundries.

Will you accord us an interview?

GUNN, RICHARDS & COMPANY

Production Engineers and Public Accountants.....

43 WALL STREET, 43 EXCHANGE PLACE, NEW YORK

50 CONGRESS STREET, BOSTON

224 ST. JAMES STREET, MONTREAL

Grinding Machinery:
Adams Co., Dubuque, Ia.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Norton Co., Worcester.
Ransom Mfg. Co., Oshkosh, Wis.

Grinding Wheels:
Norton Co., Worcester.

Hammers:
Independent Pneumatic Tool Co., Chicago.

Hammers (Pneumatic):
Chicago Pneumatic Tool Co., Chicago.

Hammers (Pneumatic Chipping):
Ingersoll-Rand Co., New York.

Heating & Ventilating Apparatus:
American Blower Co., Detroit.
Sturtevant Co., B. F., Boston.

Hoists:
Curtis & Co., Mfg. Co., St. Louis.
General Pneumatic Tool Co., Montour Falls, N. Y.
Harrington Son & Co., Edwin, Philadelphia.
Niles-Bement-Pond Co., New York.
Northern Engrg. Works, Detroit.
Pawling & Harnischfeger, Milwaukee.
Sellers & Co., Inc., William, Philadelphia.
Whiting Fdy. Equipment Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York.

Hoists (Pneumatic):
Chicago Pneumatic Tool Co., Chicago.
Ridgway & Son, Craig, Coatesville, Pa.

Hydrofluoric Acid:
General Chemical Co., Philadelphia.

Industrial Ry. Equipment:
Atlas Car & Mfg. Co., Cleveland.
The Gregg Company, Ltd., Newburg, N. Y.
Wiener Co., Ernest, New York.
Wonham & Magor, New York.

Iron Ore:
Rogers, Brown & Co., Cincinnati.

Ladles:
Northern Engrg. Works, Detroit.
Smith, J. D., Foundry Supply Co., Cleveland.

Magnets (Lifting):
Electric Controller & Supply Co., Cleveland.

Molding Machines:
Adams Co., Dubuque, Ia.
Arcade Manufacturing Co., Freeport, Ill.
Berkshire Mfg. Co., Cleveland.
Bonvillian, Ph. & E. Ronceray, Paris, France.
Herman Pneumatic Machine Co., Zelienople, Pa.
Manning, Maxwell & Moore, New York.
Maywood Foundry & Machine Co., New York.
Mumford Co., E. H., Philadelphia.
Paxson Co., J. W., Philadelphia.
Pridmore, Henry E., Chicago.
Rathbone, John A., Detroit.
Smith, J. D., Foundry Supply Co., Cleveland.
Tabor Mfg. Co., Philadelphia.
Turner Machine Co., Philadelphia.

Pattern Letters:
Shanafelt Mfg. Co., Canton, O.

Packing (Rubber Sheet):
Smooth-On Mfg. Co., Jersey City.

Parting Compounds:
Partamol Co., New York.

Parting Materials:
Doggett, Stanley, New York.

Patterns (Metal & Wood):
Herman Pneumatic Machine Co., Zelienople, Pa.

Pattern Shop Equipment:
Fox Machine Co., Grand Rapids, Mich.

Phosphorizers:
McCullough-Dalzell Crucible Co., Pittsburg.

Phosphor Tin:
Crescent Phosphorized Metal Co., Philadelphia.
New Era Mfg. Co., Kalamazoo.

Pig Iron:
Addy & Co., Mathew, Cincinnati.
Baird & West, Detroit.
Bartlett & Co., N. S., Boston.
Cherry Valley Iron Co., Pittsburg.
Columbus Iron & Steel Co., Columbus.
Dalton, Nash & Co., New York.
De Camp Bros. & Yule, St. Louis.
Dimmick & Co., J. K., Buffalo.
Domhoff & Joyce Co., Cincinnati.
Elliott, Debevoise & Anderson, New York.
Field Sales Agency, Robert, Cincinnati.
Goodrich & Co., F. A., Detroit.
Hillman & Son, J. H., Pittsburg.
McKeefrey & Co., Leetonia, O.
Mohr, J. J., Philadelphia.
Pickands, Brown & Co., Chicago.
Pickands, Mather & Co., Cleveland.
Pilling & Crane, Philadelphia.
Rogers, Brown & Co., Cincinnati.
Shepard, Chas. G., Buffalo.
Stevens, F. B., Detroit.
Thomas Furnace Co., Milwaukee.
Walter-Wallingford & Co., Cincinnati & Pittsburg.

Plumbago:
Dixon Crucible Co., Jos., Jersey City.
Gautier & Co., J. H., Jersey City.
Hill & Griffith Co., Cincinnati.
McCullough-Dalzell Crucible Co., Pittsburg.
Obermayer Co., S., Cincinnati.
Pettinos Bros., Bethlehem, Pa.
Ross-Tacony Crucible Co., Philadelphia.
Smith, J. D., Foundry Supply Co., Cleveland
Stevens, F. B., Detroit.
United States Graphite Co., Philadelphia.

Polishers' & Platers' Supplies:
Stevens, F. B., Detroit.

Riddles:
Adams Co., Dubuque, Ia.
U. S. Chaplet Co., New York.

Sand:
[redacted] Sand Bank Co., Newport, Ky.
Paxson Co., J. W., Philadelphia.
Pangborn Co., Thos. W., New York.
Standard Sand & Machine Co., Cleveland.
Stevens, F. B., Detroit.

Continued on page 132.

A case in point

By the methods we installed, a foundry whose full capacity was supposed to be 12 tons per day with a cost of $3.44 per 100 lbs., was shown to be operating at a loss of several thousand dollars per month. It was actually possible to buy a certain class of castings at a less cost than the foundry in question could produce them.

The cost record we installed resulted in a thorough overhauling of several departments. In two months the foundry was producing at a rate of 17 tons per diem, and the cost per 100 lbs. had dropped from $3.44 to $2.75. Under their old methods the loss which this foundry was suffering every month and the conditions at fault could not possibly have been discovered until the end of the fiscal year.

A system of cost accounting that doesn't give you all the facts you want when you want them is sometimes very expensive.

Our foundry work is under the personal supervision of Mr. Ellsworth M. Taylor.

Systematizing department

Library Bureau

316 Broadway, New York

Sand Blast Machinery:

Drucklieb, C., New York.
Pangborn Co., Thos. W., New York.
Paxson Co., J. W., Philadelphia.
Tilghman-Brooksbank Sand Blast Co., Philadelphia.

Sand Mixing Machinery:

Falls Rivet & Machine Co., Cuyahoga Falls, O.
Mumford, E. H., Philadelphia.
Pangborn Co., Thos. W., New York.
Sellers & Co., Inc., William, Philadelphia.
Standard Sand & Machine Co., Cleveland.

Sand Sifters:

Chicago Pneumatic Tool Co., Chicago.
Deane Steam Pump Co., Holyoke, Mass.
Hanna Engrg. Works, Chicago.
Herman Pneumatic Machine Co., Zelienople, Pa.
Standard Sand & Machine Co., Cleveland.

Saws (Cold Cutting):

Tabor Mfg. Co., Philadelphia.

Seacoal:

Hill & Griffith Co., Cincinnati.
Obermayer Co., S., Cincinnati.
Paxson Co., J. W., Philadelphia.

Separators (Magnetic):

Dings Electro Magnetic Sep. Co., Milwaukee.
Elm City Engineering Co., New Haven.
Pangborn Co., Thos. W., New York.

Shafting (Flexible):

Stow Mfg. Co., Binghamton, N. Y.

Shop Equipment:

Mfg. Equipment & Engineering Co., East Boston, Mass.

Shovels:

Stevens, F. B., Detroit.

Sprue Cutters:

Barnett Fdy. Co., Oscar, Newark.
Shuster Co., F. B., New Haven.
Middleditch, Benj., Detroit.

Stoppers:

McCullough-Dalzell Crucible Co., Pittsburg.
Ross-Tacony Crucible Co., Philadelphia.
Taylor, Robert J., Inc., Philadelphia.

Stove Trimmings:

Burdick & Son, Albany, N. Y.

Testing Machines:

Keep, W. J., Detroit.

Thermit Process:

Goldschmidt Thermit Co., New York.

Tools (Molders'):

Dobson, William, Canastota, N. Y.
Obermayer Co., S., Cincinnati.
Paxson Co., J. W., Philadelphia.
Smith Foundry Supply Co., J. D., Cleveland.

Tools (Pneumatic):

Chicago Pneumatic Tool Co., Chicago.
Ingersoll-Rand Co., New York.
Independent Pnuematic Tool Co., Chicago.

Tramrail Systems:

Randall & Co., R. T., Philadelphia.

Tumbling Mills:

Adams Co., Dubuque, Ia.
Falls Rivet & Mch. Co., Cuyahoga Falls, O.
Gilmour, J., New York.
Sly, W. W. Mfg. Co., Cleveland.
Smith, J. D., Foundry Supply Co., Cleveland.

Twyers, Cupola:

Watt Cupola Twyer Co. Barnesville, Ohio.

Wire Straighteners:

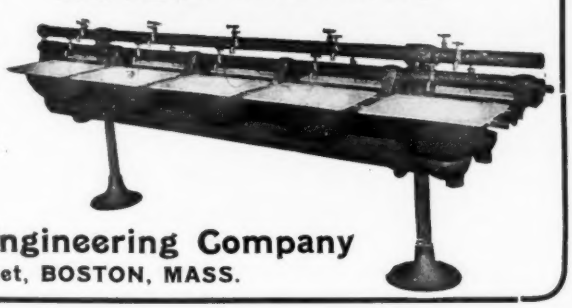
Shuster Co., F. B., New Haven.
Blake Mfg. Co., Geo. F., New York City.

SANITARY WASH BOWLS

Clean, compact and practical. Individual galvanized or enameled metal bowls. Single or double batteries. Complete equipments ready to connect with cold, tempered or hot and cold water supply.

You cannot afford to make or use former utilities of this nature in comparison with this strictly up-to-date device.

Send for Catalog.



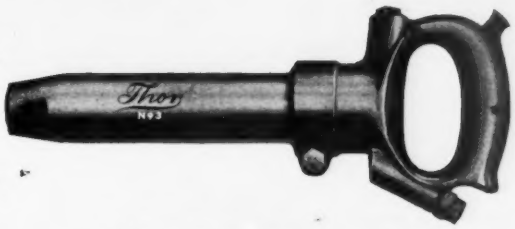
Mfg. Equipment & Engineering Company
209 Washington Street, BOSTON, MASS.

Thor AIR HAMMERS

Most Powerful, Durable and Efficient Yet Produced.

Unexcelled for Chipping Castings

Made in all sizes.



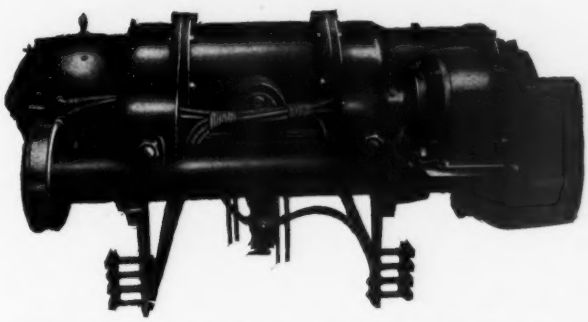
No Vibration
Simple in Design
Sent on Trial at Our Expense

Write for new catalog No. 7.

INDEPENDENT PNEUMATIG TOOL CO.

Manufacturers of Air Hammers and Drills

First Nat'l Bank Bldg. CHICAGO. | Farmers Bank Bldg., PITTSBURG. | 170 Broadway, NEW YORK.



SHEPARD ELECTRIC CRANE TROLLEY

Splash-Oiled Spur Gearing, Accessibly Inclosed, Immune from Dirt

THE GENERAL PNEUMATIC TOOL COMPANY

NEW YORK SINGER BUILDING | General Office and Works: MONTOUR FALLS, N. Y. | PHILADELPHIA STEPHEN GIRARD BLDG.

UNDISPLAYED ADVERTISEMENTS

WANTED and FOR SALE

Undisplayed advertisements will be inserted under this head at 40 cents per line each insertion.

PROPERTY FOR SALE

FOR SALE OR RENT.—Large foundry. Plenty of work. Located in Northern Ohio. Will sell on easy terms. Address Box 818, THE FOUNDRY, Cleveland. Ohio.

FOR SALE CHEAP.—Jobbing foundry, including full equipment, and at present in operation, with established business. Paying well. Positively good reasons for selling. Reliable Foundry & Machine Co., Quincy, Ill.

An enterprising foundryman and machinist with capital, who desires to own and manage a good business in one of the most promising of young western cities, will be fully repaid by writing F. Glenn, Lewiston, Idaho. Splendid inducements offered capable parties.

FOR SALE.—A small foundry located in Central New York, 3 miles from fast growing city of about 10,000 inhabitants on one of the leading Railways of the state. Good established business, employing three to four men steady. Only foundry within 40 miles. Easy terms. Address Box 843, THE FOUNDRY, Cleveland, O.

FOR SALE.—A completely equipped Brass Foundry and machine shop for the manufacture of Plumbers' goods. A splendid line of patterns and new machinery and tools. Trade well established. Situated where there are no labor troubles and within 100 miles of Chicago. Address Box 814, THE FOUNDRY, Cleveland, O.

FOUNDRY AND MACHINE SHOP FOR SALE, with good will, in northeastern part of Philadelphia. Plant now running and is complete, with core shop, engine, rattlers and cupola with capacity for 5-ton heats. Area of property 12,000 square feet; streets on two sides. Good local jobbing trade; owners consolidating plants elsewhere. Full particulars may be obtained by addressing Box 836, THE FOUNDRY, Cleveland, O.

INVESTMENT

WANTED.—A live man with two to three thousand dollars to invest in Foundry and conduct same in connection with machine shop now in operation in live town in Southern Georgia. Address Box 813, THE FOUNDRY, Cleveland, O.

PARTNER WANTED.—With some capital for a foundry and machine shop in a good Kentucky town of 10,000 people. Must be a good all around mechanic and able to act as foreman in the foundry. To the right party, who is tired of working for others, and wants to do something for himself, good inducements will be given. Address Box 837, THE FOUNDRY, Cleveland, O.

WANTED.—A thoroughly practical and up-to-date foundryman who can invest $20,000 to $25,000 in a modern foundry and who can manage same himself. Have a good proposition in the middle west. There are three machine shops and a railroad shop in close proximity whose long established trade can be obtained and who uses medium and heavy castings of high grade, weighing from one pound to 20,000 pounds. No other foundry within 40 miles. Present foundry, unable to supply demand, has been turning away a large amount of work for several years. This proposition will bear the closest investigation and correspondents must furnish reference. It is also straight business and no promoters need answer. Address Box 838, THE FOUNDRY, Cleveland, O.

FOR SALE, MISCELLANEOUS

FLUOR SPAR.—Lump and Gravel. Special Qualities. Delivered Eastern Ports. Enquiries solicited. DRABBLE BROS., Mineral Merchants, Matlock, England.

FOR SALE.—Two second-hand cupolas in first-class condition. Shells 72"-82" in diameter and about 40 ft. high. Address Box 800, THE FOUNDRY, Cleveland, Ohio.

BLOWER BARGAINS.
Roots Second-Hand Blowers, bought, sold or exchanged for new ones. Address,
H. M. PAPWORTH,
120-122 Liberty Street, New York City.

FOR SALE:—
1 second-hand 25-horsepower center crank Nagle engine complete $75.00
1 second-hand No. 7 Sturtevant Blower, complete $25.00
1 second-hand 2,000-lb. O'Donnell Elevator complete $75.00
For further particulars apply to the Ashtabula Foundry Co., Ashtabula, O.

FOR SALE:—
One second-hand 7-ton Foundry Crane, made by Craig. Ridgway & Co.
One second-hand Foundry Elevator.
One second-hand Cupola, 48" diameter, complete.
One second-hand Cupola, 60" diameter, complete.
One second-hand Root Positive Blower.
One second-hand Connersville Positive Blower.
All the above machinery is in strictly first class condition; but we are increasing our capacity, and will sell this machinery at a bargain. The Casey-Hedges Co., Chattanooga, Tenn.

FOR SALE.—The following foundry machinery; all in good repair:
One No. 4 Whiting Fdry. Co. Cupola.
One 6-ton Jib Crane.
One 1-ton Jib Crane.
One 45" Buffalo Cupola Blower.
One 6-ton Geared Ladle.
One 3-ton Geared Ladle—Whiting Foundry make.
William R. Perrin & Company,
Loomis & Forty-sixth Sts.,
Chicago, Ill.

WANTED, MISCELLANEOUS

WANTED.—Second-hand cupola, 4 to 8 tons capacity. Gilson Mfg. Co., Port Washington, Wis.

WANTED.—42" Schwartz furnace. Give description and price. Address Box 826, THE FOUNDRY, Cleveland, O.

HELP WANTED.

Undisplayed advertisements will be inserted under this head at 25 cents per line each insertion.

SUPERINTENDENT WANTED

ASSISTANT SUPERINTENDENT wanted for an iron foundry and machine shop employing about 350 men. Must have good executive ability and be familiar with methods that produce results. State age, references, synopsis of experience and salary expected. Address Box 795, THE FOUNDRY, Cleveland, O.

SUPERINTENDENT WANTED for steel foundry making specialty light and medium weight castings. Must be experienced and familiar with side-blow converter process. Give amount experience, reference and state if practical molder. Address Box 833, THE FOUNDRY, Cleveland, O.

CONTINUED ON PAGE 136